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On the Defective Manufacture of Railroad Bars. By Wm. Truran, Fsq.

With the introduction of railroads, in the truly national sense of the expression, the attention of numerous scientific and practical men was directed to the deflexion of rail bars under the various pressures to which they were subjected, the object of their inquiries being the discovery of a form which should possess the greatest stiffness, both vertically and laterally, with the smallest consumption of metal.

The fish-bellied rail was, on its invention, considered to possess these properties in a remarkable degree; but from causes which need not here be detailed, the calculations which were formed regarding its stability, were not realized in practice, and it was replaced by others of a parallel form. Wrought rail bars are now rolled of one uniform depth from one end to the other, without reference to their sectional construction. It is to bars of this form, then, that scientific men have directed their attention by testing, in various ways, their capabilities and qualities. The deflexion of rails of different depths and weights when placed on the same bearings under similar loads; the deflexion of a rail at various bearings with the same weight; and the deflexion of the same rail at fixed bearings, but variously loaded, has been ascertained, by direct experiments conducted by competent engineers, who have recorded their observations in scientific journals in the United States and England. The beneficial effects of the publicity given to their inquiries is beginning to be seen, in the increased depth and weight of the rail bars now making over those

manufactured a few years since, and in the reduction of the distances between the bearings (where intermediate supports are adopted in preference to the longitudinal system,) from the dimensions originally fixed upon as the most proper. By thus increasing the depth and weight of the rail, conjointly with a diminution of the distance between its supports, the strength of the rail bar is immensely increased, and the deflexion from a right line on the passage of heavily laden carriages, is exceedingly small on judiciously proportioned roads worked with suitable stock.

Although the proportions of rail bars most conducive to economy in the expenditure of metal and working power, has been ably investigated by scientific men of great attainments, yet, in consequence of the difficulty and expense necessarily attending any extensive experiments on heavy metallic bars, added to the limited acquaintance possessed by such men of the process of manufacturing rail bars, much important information may still be acquired by those possessed of the means and inclination for making further experiments—especially, if their inquiries be directed to the different effects produced on the finished rail bars by departures from the mode of manufacturing usually pursued. The most correct deductions will be obtained where the requisite science is combined with an intimate practical acquaintance with the modes of manufacture adopted. Manufacturers, themselves, would, therefore, appear to be the most eligible parties for conducting such investigations; but, a blind adherence to established rules and procedure, is eminently characteristic of rail manufacturers. Rarely endowed with the desire and abilities for elucidating the causes of the phenomena daily witnessed in their factories, and abundantly occupied with the management of their properties, science has secured little assistance or encouragement from them beyond the adoption of its principal discoveries, when these have resulted in an immediate diminution of the expenses of manufacturing. As a necessary consequence of this incompetence to deal with subjects requiring scientific research, sufficient attention is not paid to the various effects produced on rail bars by causes which, from their simplicity and apparent insignificance, are too often considered as beneath the notice of practical men, but which are in reality of the greatest importance.

The writer has already noticed in previous numbers of this *Journal*, the injurious effects produced on rail bars by the employment of various size bars in the same pile, by which seven-eighths of the bars made are rendered less or more unsound, and has described a simple means whereby metal of a fibrous structure may be readily converted into bars of a crystalline fracture. It now remains only to notice the extraordinary discrepancies observed in the deflexion of rails of the same pattern and quality when placed on the same blocks, loaded with similar weights for similar periods of time, to show the utter inattention exhibited at iron works to the most essential particulars to be attended to in manufacturing malleable iron rail bars.

The attention of the writer was directed to the subject of deflexion, by observing that bars of reduced section frequently deflected less from a straight line than others of a heavier and, undoubtedly stronger section. And what appears equally strange, the deflexion of bars made in the same manner and within a few minutes of each other, differed very considera

bly: while one bar deflected 1 inch, another of precisely the same pattern and make, deflected 1·5 inch under similar circumstances. Still greater irregularities have been noticed in the proving machine.

Extraordinary as this irregularity in the deflexion of similar bars under like circumstances may appear, the quantity of permanent deflexion or 'set,' remaining after the removal of the pressure, differed still more widely in the case of different bars. It was ascertained by numerous experiments, that the 'set' taken by some bars was twelve times that taken by others.

It was at first supposed that this difference arose from some variation or irregularity in the mode of piling, and also in the quality of the metal employed. Alterations were therefore made in the piling, and the results noted, but the irregularity of the deflexion was equally great as before. The quality of the metal was then correctly ascertained and disposed in the most effective manner for offering the greatest resistance to the compressing and tensile forces, but without success. Attention was next directed to the heating and rolling processes, when it was discovered that the deflexion was slightly affected by the mode in which the heating had been conducted. The primary cause, however, remained undiscovered, and further experiments were required to ascertain the cause of this widely spread, though little known, defect in railroad bars.

In the course of the preceding experiments to discover the defect, by altering the arrangement of the piles and the disposition of the various qualities of metal, it was frequently observed that the same rail was more elastic when pressed on one side than when pressed on the other, although of that form known as the parallel double-head rail with the same quantity and a similar quality of metal in each head. On repeating the experiments and recording the results, it was observed that in very few of the bars was the strength to resist compression the same from either side. The variation was very great, and after carefully conducted observations, the same difficulty in arriving at a satisfactory solution of the cause was experienced as in the previous experiments, having for their object the discovery of the cause by which different bars possessed different degrees of elasticity. The quality of the metal and manner of working, were found to affect it, but in a degree too inconsiderable to be considered as the acting cause.

The importance of the subject, and the beneficial results aimed at, rendered the inquiry one of no common interest, and, notwithstanding the non-success which had attended the experiments thus far tried, the subject was prosecuted, but instead of confining the inquiry to the quality of the metal and mode of working, circumstances pointed out the propriety of taking into consideration the form of the bar before passing through the finishing operation, termed 'cold straightening,' and, trifling as it may seem, the longitudinal form of the rail was found to exercise a most important influence on its strength to resist deflexion. Indeed, the great variation in the deflexion of rails when tested under like circumstances, was ultimately discovered to be owing to the form of the rail before cold straightening. If perfectly straight, and the quantity of metal disposed equally, the deflexion on the application of the pressure to each side will be nearly alike; but if it partakes of a curved profile, the deflexion will

be unequal, and its elasticity also, will be greater when on one side than when on the other. From the little attention which has been paid to this department of the manufacture, the greater number of the rails are less or more curved before undergoing the cold straightening process.

In the majority of rails that are made, the bulk of metal in the head is greater than that in any other part, and, in cooling, this mass of metal retains the heat so much longer than the thinner portions of the bar, that it contracts after the other portions have parted with their caloric, and impart to the upper or wearing side of the bar a concave outline. To counteract this tendency to assume a curved form, the bar is bent over a convex block whilst hot, by which means it becomes curved in an adverse direction; hence the change of form which occurs in cooling tends to produce straightness. The convexity given to the bar when hot, is equal to the concavity which it would assume in cooling from a straight line; theoretically, therefore, it should require no after straightening, but practically, it is otherwise. The bars when stocked on the rail bank are variously curved, some convex, others concave—very few approaching the desired straightness. This irregularity occurs principally from the different temperatures possessed by the bars when being curved; the convex block having been made to suit the most usual temperature of the bars when they arrive at this point of the manufacture, any excess or diminution therefrom will result in a corresponding deviation from a straight line. In the case of parallel double-head rails, the operation of curving is unnecessary, but the unequal rates of expansion and contraction of different descriptions of metal, not unfrequently cause such bars to deviate considerably from a right line.

Of the sufficiency of this agent to cause the irregularity mentioned, there can, on an examination of the subject, be but one opinion. Assuming that the bar before straightening has a concave profile which is to be brought straight by hammering or pressure, it will be evident that the particles of metal on the concave side must be violently distended, and those on the under or convex side will be compressed to produce this result. To understand better the effects of this forced straightening, the generally received opinion that wrought iron is inelastic, must be abandoned, when it will be conceded that the particles of metal forcibly strained, acting in concert with those compressed, have a direct tendency to restore the bar to its original profile. If, then, this bar be laid on supports or continuous bearings, there will be, in addition to the pressure excited by the load, the direct tendency of the metal in the bar to return to its curve to deflect it from a right line.

On the other hand, if the rail bar had been convex on the upper side and concave on the lower, the effect of straightening it would be the lateral compression of the upper fibres conjointly with an elongation of the lower strata of fibres—the reverse, in short, of the above—thus, at one and the same operation, adding to the closeness of the resisting media and bringing the tensile properties of the lower portion of the bar into a state of permanent tension. The properties of the metal having been brought into full play while the bar is in a quiescent state, the deflexion, on the application of the load, is immediately retarded, and the ultimate descent is also from the same cause greatly diminished from what it would other-

wise be. That this view of the matter is correct, we may adduce in its support the well known fact that the application of a weight on a perfectly straight rail which has received no cold straightening, results in an immediate deflexion from a right line proportionable to the load and length between supports, and this deflexion will increase until the resistance offered by the metal to the further compression of the upper and distension of the lower parts of the bar equals the weight applied.

The experiments herein alluded to, were made principally on rails of the double-head pattern weighing about 70 pounds per yard. They were placed on cast iron supports 13 feet 1·5 inches between bearings; at this bearing a weight of 4300 pounds was suspended on the centre of the rail for one minute. With bars straight from the rail bank, the deflexion on the application of this load averaged 1·380 inches. With bars which had a rise or convexity of the upper surface of ·5 inch, which was subsequently removed by cold straightening, the descent was 1·181 inches, but with a rise of 1·3 inches, the descent or deflexion on the application of this weight, was ·986 inch only. These are the average results from more than 400 bars tested in this manner. They exhibited in the most conclusive manner, that increased strength to resist deflexion may be imparted to the rail by attention to its longitudinal form before being cold straightened.

The inability of the bars to resist deflexion when they had a concave profile, was demonstrated by a few experiments on bars which had a concavity of ·5 inch before cold straightening. The application of the load of 4300 pounds, resulted in an immediate deflexion of 1·763 inches, or ·383 of an inch more than with bars which had received no cold straightening. With bars having a concavity of more than ·5 inch before straightening, it was observed that the deflexion was proportionably greater. The deflexion being 1·380 inches with bars which had not been cold straightened, this dimension added to the quantity of concavity taken out by hammering or other straightening, gave the deflexion of such bars very nearly.

The deflexion which remained after the removal of the load of 4300 pounds, varied with the amount of convexity given to the rail. In those which had been brought out from the rail bank straight, the deflexion or permanent set from a straight line occasioned by this weight, was equal to ·102 inch. The bars which had a convexity of ·5 inch before straightening, retained a permanent set of ·057 inch, but those which had been curved to the extent of 1·3 inches before straightening, retained after the removal of the load a permanent set of ·0118 inch only. Rails which had been hammered straight from a concave profile, retained a permanent deflexion much greater than the others. Instances were recorded of such bars retaining a set of ·210 after the removal of the load.

During the experiments it was observed, that curving the rail so that it had a convexity of more than 1·3 inches in 13 feet 1·6 inches was not attended with corresponding advantage. This is the highest curvature that should be attempted in practice with the metal commonly used. If it is exceeded, the permanent strain on the lower fibres of metal produced by the cold straightening appears to weaken the rail. In the course

of some experiments, having a different object in view, it was ascertained that the rails usually manufactured for railroad companies, would not bend cold to a less radius than 20 inches without fracture of the outer rim of metal; and when curved of a greater radius, the effect of the curvature was to diminish the strength of the rail to resist fracture from a weight falling freely on it while supported on cast-iron blocks, in a ratio corresponding nearly to the radius to which it had been curved.

In the course of these experiments, one other fact was discovered, having a material influence on the strength of rail bars, which it may be proper here to record. We have already stated, that the deflexion of a straight bar which had received no hammering, after cooling with a load of 4500 pounds on the centre between supports 13 feet 1·5 inches apart, averaged 1·380 inches, and the permanent set, ·102 inch. A number of the rails thus tested were submitted to a repetition of the test after standing one hour unloaded, when it was ascertained that they descended still further; the additional deflexion averaging ·039 of an inch, but on the removal of the weight the permanent set occasioned by this second test, in addition to that caused by the first, amounted on the average to ·013 inch only. On a number of bars, the test was repeated a third time, after they had stood 12 hours, with still more striking results. The additional deflexion due to the third testing, averaged ·004 inch, and the permanent set ·003 inch. These experiments show the importance of bringing the tensile properties of the metal in action before applying the load, if a minimum deflexion is desired. But their application, by causing a departure from a straight line in the finished rail, is inadmissible in practice. It can be done, however, in the manner we have described, viz. by giving the surface of the rail a convex profile while hot, and afterwards bringing it straight by hammering or pressure when cold.

From inattention to this property of iron rail bars, the rails on the majority of the roads constructed have, from the passage of heavy engines and loaded cars, deflected from a straight line, so as to present a concave profile varying in its depression from a right line from one to five-tenths of an inch.

The facts herein detailed are deserving of attention from engineers generally, now that wrought iron is extensively used in various structures. We may cite an instance of its successful application in the construction of an iron building, where wrought iron wall plates, 22 feet long by 7 inches deep, supported at this distance apart by iron pillars, carried the iron couples and slate roof of a building 33 feet span in the clear. The increased stiffness attained by curving rail bars when hot, induced the application of the principle to these wall plates, which were curved 1·75 inches—the convex side being placed uppermost. On the completion of the structure, the wall plates deflected from their previous form until they became nearly straight. Hence, had they been straight when put up, the deflexion of 1·75 inch from a straight line would have produced a convexity in the under side of like amount, and, consequently, disturbed the whole of the frame-work of the roofing.

*On the Strength of Locomotive Boilers and the Causes which lead to Explosion.**† By William Fairbairn, F.R.S.

(Continued from page 7.)

The statements contained in the earlier part of this paper regarding the strength of the stays of the fire-box would have been incomplete if we had not put those parts of a locomotive boiler, comprised in the flat surfaces or sides of a fire-box, to the test of experiment. This was done with more than ordinary care; and in order to attain conclusive results, two thin boxes, each 22 inches square and 3 inches deep, were constructed; the one corresponding in every respect to the sides of the fire-box, distance of the stays, &c., the same as those which composed the exploded boiler; and the other formed of the same thickness of plates, but different in the mode of staying, which, in place of being in squares of 5 inches asunder, as those contained in the boiler which burst, were inserted in squares of 4 inches asunder. The first contained sixteen squares of 25 inches area, representing the exploded boiler, or old construction; and the other, twenty-five squares of sixteen inches area, representing the new construction.

To the flat boxes thus constructed, the same lever, valve, and weight were attached as used in the previous experiments; and having applied the pumps of a hydraulic press, the following results were obtained:—

Table III.—*Experiment 1st.—To determine the ultimate Strength of the flat surfaces of Locomotive Boilers when divided into squares of 25 inches area.*

No. of Experiment.	Pressure in lbs. per sq. inch.	Swelling of the sides, in inches.	No. of Experiment.	Pressure in lbs. per sq. inch.	Swelling of the sides, in inches.
1[1]	245	+	11	545	·05
2	275	+	12	575	·05
3	305	+	13	605	·06
4	335	+	14	635	·06
5	365	+	15	665	·06
6	395	+	16	695	·07
7	425	+	17	725	·07
8	455	·03	18	755	·07
9	485	·03	19	785	·08
10	515	·04	20	815	—[2]

[1] The box representing a portion of the flat surface of the side of the fire-box of a locomotive boiler was composed of a copper plate, on one side ½-inch thick, and an iron plate on the other ⅝-inch thick, being the same in every respect as the boiler which exploded.

[2] Burst by drawing the head of one of the stays through the copper, which, from its ductility, offered less resistance to pressure in that part where the stay was inserted.

The above experiments are at once conclusive as to the superior strength of the flat surfaces of a locomotive fire-box, as compared with the top, or even the cylindrical part of the boiler; but taking the next ex-

* Extracted, by permission, from the forthcoming Volume of the 'Transactions' of the British Association for the Advancement of Science.

† From the Lond. Civil Eng. and Arch.'s Journ. June, 1854.

periment, where the stays are closer together, or where the areas of the spaces are only 16 instead of 25 square inches, we have an enormous resisting power; a force much greater than anything that can possibly be attained, however good the construction, in any other part of the boiler.

TABLE IV.—*Experiment 2d.—To determine the ultimate Strength of the flat surfaces of Locomotive Boilers when divided into squares of 16 inches area.*

No. of Experiment.	Pressure in lbs. per sq. inch.	Swelling of the sides, in inches.	No. of Experiment.	Pressure in lbs. per sq. inch.	Swelling of the sides, in inches.
1[1]	245	+	25	965	·09
2	275	+	26	995[2]	+
3	305	+	27	1025	+
4	335	+	28	1055	+
5	365	+	29	1085	+
6	395	+	30	1115	+
7	425	+	31	1145	+
8	455	+	32	1175	+
9	485	+	33	1205	+
10	515	·04	34	1235	+
11	545	·04	35	1265	+
12	575	·04	36	1295	·09
13	605	·06	37	1325	·09
14	635	·06	38	1355	·10
15	665	·07	39	1385	·11
16	695	·07	40	1415	·11
17	725	·07	41	1445	·12
18	755	·08	42	1475	·13
19	785	·08	43	1595	·14
20	815	·08	44	1535	·16
21	845	·08	45	1565	·22
22	875	·08	46	1595	·34
23	905	·08	47	1625	—[3]
24	935	·08			

[1] The flat box on which these experiments were made, has the same thickness of plates as that experimented upon in the preceding table, viz., one side of copper $\frac{1}{2}$-inch thick, and the other of iron $\frac{3}{8}$-inch thick. The only difference between the two is the distance of the stays, the first being in squares of 25 inches area, and the other in squares of 16 inches area.

[2] From 995 to 1295 lbs., the swelling or bulge on the side was inappreciable.

[3] Failed by one of the stays drawing through the iron plate after sustaining the pressure upwards of $1\frac{1}{2}$ minute.

In the above experiments, it will be observed, that the weakest part of the box was not in the copper, but in the iron plates, which gave way by stripping or tearing asunder the threads or screws in part of the iron plate at the end of the stay.

The mathematical theory would lead us to expect that the strength of the plates would be *inversely as the surfaces between the stays;* but a comparison of the results of these experiments shows that the strength decreases in a higher ratio than the increase of space between the stays. Thus, according to the mathematical theory, we should have—

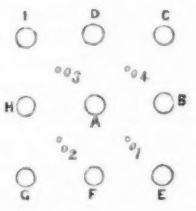
Ult. strength 2d plate per sq. in. = strength 1st plate $\times \frac{25}{16} = 815 \times \frac{25}{16} = 1273$ lbs.

Now this plate sustained 1625 lbs. per square inch, showing an excess

of about one-fourth above that indicated by the law. This is in excess of the force required to strip the screw of a stay $\frac{1}{16}$-inch in diameter, such as those which formed the support of the flat surfaces in the exploded boiler.

It will be found that a close analogy exists throughout the whole experiments, as respects the strengths of the stays when screwed into the plates, whether of copper or iron; and that the riveting of the ends of the stays adds to their retaining powers an increased strength of nearly 14 per cent. to that which the simple screw affords. The difference between a fire-box stay when only screwed into the plate and when riveted at the ends is therefore in the ratio of 100 : 76, nearly the same as shown by experiment in the Appendix.

Fig. 2.



It is desirable, therefore, that we should ascertain the strain exerted on each stay or bolt of the fire-box. Let A,B,C,D,E,F, represent the ends of the bolt or stays; O_1, O_2, O_3, O_4, the centres of the squares formed by bolts. Suppose a pressure to be applied at each of the points O_1, O_2, O_3, O_4, equal to the whole pressure on each of the squares; then the central bolt A, will sustain one-fourth of the pressure applied at O_1, also one-fourth of the pressure applied at O_2, and so on; so that the whole pressure on A, will be equal to the pressure applied to one of the square surfaces. Hence we have—

Strain on the stay of Table III. $= \frac{815 \times 25}{2240} = 9$ tons.

Strain on the stay of Table IV. $= \frac{1625 \times 16}{2240} = 11\frac{1}{2}$ tons nearly.

The stay in the latter case was $\frac{3}{16}$-inch in diameter; hence the strain upon one square of section would be about 13 tons, which is considerably within the limits of rupture of wrought iron under a tensile force.

In the experiments here referred to, it must be borne in mind, that they were made on plates and stays at a temperature not exceeding 50° Fah.; and the question naturally occurs as to what would be the difference of strength under the influence of a greatly increased temperature in the water surrounding the fire-box, and that of the incandescent fuel acting upon the opposite surface of the plates.

This is a question not easily answered, as we have no experimental facts sufficiently accurate to refer to; and the difference of temperature of the furnace on one side, as compared with that of the water on the other, increases the difficulty, and renders any investigation exceedingly unsatisfactory. Judging, however, from practical experience and observation, Mr. Fairbairn is inclined to think that the strengths of the metals are not much deteriorated. His experiments on the effects of temperature on cast iron do not indicate much loss of strength up to a temperature of 600°. Assuming, therefore, that copper and wrought iron plates follow the same law, and taking into account the rapid conducting powers of the former, we may reasonably conclude that the resisting powers of the plates and stays of locomotive boilers are not seriously affected by the increased temperature to which they are subject in a regular

course of working. This part of the subject is, however, entitled to future consideration; and it may be hoped that some of our able and intelligent superintendents will institute further inquiries into a question which involves considerations of some importance to the public, as well as to the advancement of our knowledge in practical science.

Appendix.

In order to test with accuracy the tensile power of the different descriptions of stays used in locomotive boilers, and to effect a comparison between those screwed into the plates and those both screwed and riveted, it was deemed expedient to repeat Mr. Ramsbottom's experiments on a larger scale; and by extending the tests to copper stays as well as iron ones, it was considered that no doubt could exist as to the ultimate strength of those simply screwed, the tensile powers of the stays themselves, and the relative difference between those and the finished stays when screwed and riveted on both sides of the fire box. The large lever and requisite apparatus being at hand, the experiments proceeded as follows:

Experiments to determine the Ultimate Strength of Iron and Copper Stays generally used in uniting the flat surfaces of Locomotive Boilers.

Experiment I.—Iron stay $\frac{3}{4}$-inch diameter, screwed into a copper plate $\frac{5}{8}$-inch thick (as fig. 3.)

No. of Experiment.	Weight in lbs.	No. of Experiment.	Weight in lbs.
1	9,860	4	14,900
2	11,540	5	16,580
3	13,220	6	18,260 [1]

[1] With the last weight, 18,260 lbs.=8·1 tons, the threads in the copper plate were drawn out or stripped after sustaining the weight a few seconds.

Experiment II.—Iron stay $\frac{3}{4}$-inch diameter, screwed and riveted into a copper plate $\frac{5}{8}$-inch thick (as fig. 4.)

No. of Experiment.	Weight in lbs.	No. of Experiment.	Weight in lbs.
1	9,860	6	18,260
2	11,540	7	19,940
3	13,220	8	21,620
4	14,900	9	23,300
5	16,580	10	24,140 [1]

[1] When the last weight, 24,140 lbs.=10·7 tons, was laid on, the head of the rivet was torn off; and the stay, along with the threads in the copper, was drawn through the plate.

Experiment III.—Iron stay $\frac{3}{4}$-inch diameter, screwed and riveted into an iron plate $\frac{5}{8}$-inch thick (as fig. 4.)

No. of Experiment.	Weight in lbs.	No. of Experiment.	Weight in lbs.
1	9,860	6	23,300
2	13,220	7	25,980
3	16,580	8	26,660
4	19,140	9	27,940
5	20,780	10	28,760 [1]

[1] With the last weight, 28,760 lbs.=12·5 tons, the stay was torn asunder through the middle, both screw and plate remaining perfect.

EXPERIMENT IV.—Copper stay $\frac{3}{4}$-inch diameter, screwed and riveted into a copper plate $\frac{3}{8}$-inch thick (as fig. 4.)

No. of Experiment.	Weight in lbs.	No. of Experiment.	Weight in lbs.
1	9,860	4	14,900 [2]
2	11,540 [1]	5	16,265 [3]
3	13,220		

[1] With 11·540 lbs. the body of the stay was slightly elongated.
[2] Elongation considerably increased with 14,900 lbs.
[3] Broke with 16,265 lbs.=7·2 tons, after sustaining the load upwards of three minutes. The ultimate elongation was 0·56 inch in a length of 3 inches.

Fig. 3.

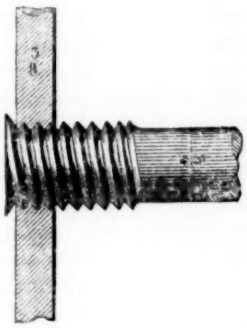
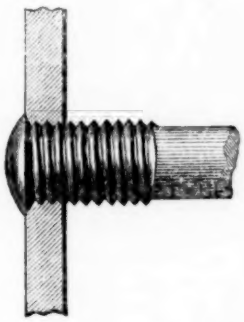


Fig. 4.



It will be observed, on comparing the results obtained from the above experiments, that iron plates and iron stays are considerably stronger than those made of copper. It may not be advisable to have the interior fire-box made of iron, on account of its inferior conducting powers and its probable durability; but so far as regards strength, it is infinitely superior to that of copper, as may be seen by the following:

Summary of Results.

No. of Experiment.	Breaking weight in tons.	Resistance per sq. inch in tons.	Ratio, Exp. III., the iron stay and iron plate taken as 1000.
III.	12·5	27·7	1000 : 1000 Iron and iron.
I.	8·1	18·8	1000 : 648 Iron and copper screwed only.
II.	10·7	23·6	1000 : 856 Iron and copper screwed and riveted.
IV.	7·2	16·1	1000 : 576 Copper and copper screwed and riveted.

On the above data, it will be found that the iron stay and copper plate (not riveted) have little more than one-half the strength of those where both are of iron; that iron stays screwed and riveted into iron plates are to iron stays screwed and riveted into copper plates as 1000 : 856; and that copper stays screwed and riveted into copper plates of the

same dimensions, have only about one-half the strength of those where both the stays and plates are of iron. These are facts in connexion with the construction of locomotive, marine, and other description of boilers having flat surfaces, which may safely be relied upon, and that more particularly when exposed to severe strain, or the elastic force of high-pressure steam.

On the Means of Avoiding Smoke from Boiler Furnaces. By Mr. W. Woodcock.*

The author commenced by explaining the nature of smoke as existing in furnaces, the cause of its formation, its component gases, and the temperature at which they became inflammable; and then pointed out a method of preventing the evolution of opaque smoke by simple and apparently effective means. It was stated that ordinary pit coal, under the process of destructive distillation, gave off various volatile substances, some of which were gases, such as hydrogen, marsh gas, olefiant gas, carbonic oxide, &c.; these and others existed in the furnace only in a gaseous state, becoming liquid or solid when in the external air; and of such, coal-tar was composed: and amidst them the carbon, in minute subdivision, was held in suspension,—giving to the smoke its sable hue. All these gases were combustible at given temperatures, provided a certain amount of oxygen was present. It was then shown that the air containing this oxygen, if imparted to the gases after leaving the fuel on the bars, must be administered so as not to reduce the temperature of the gases below their flame points.

The formation of smoke, or visible carbon held in suspension, was stated to depend entirely upon the insufficiency of the supply of oxygen in the furnace, as the heat of the furnace would cause the various gases to be given off more rapidly than their combustion could be supported by the quantity of oxygen passing through the fire-bars in the same period of time; this evil being much aggravated by the heat of the air as usually supplied from the ordinary ash-pit, generally ranging from 200° to 300° Fahr., and the air at that heat containing less oxygen, by about one-third, than at the usual atmospheric temperature; and, consequently, the combustion of the fuel to which it was supplied must be one-third less perfect.

The simplest means of preventing the formation of smoke were shown to be by providing for an ample supply of oxygen in a condensed state in the form of cold air, to the fuel on the fire-bars, and by administering such further supply of oxygen to the heated gases as might be necessary for their complete combustion whilst in contact with the boiler; this latter supply being given at such a temperature as would insure the successive ignition of the gases as they were evolved. Thus, by establishing nearly perfect primary combustion, the quantity of smoke evolved was shown to be reduced to a minimum, of which no visible trace ever reached the summit of the chimney.

The apparatus by which this desirable end was attained, was described

* From the Lond. Journ. and Rep. Science, Dec., 1854.

as consisting of two parts, each being the addition of a very simple apparatus to the ordinary boiler furnace. The first of these was a double set of thin iron bars lying horizontally in the direction of their length parallel to each other, immediately beneath the grate in the ash-pit. Each set of bars resembled a venetian blind in its arrangement; the bars being inclined at an angle of 45° to the horizon in the direction of their width. The bars of the two sets were thus inclined in opposite directions, and placed so close together that a vertical straight line could not pass between any adjacent pair of them, yet far enough apart to allow all cinders to fall freely through, and the air to pass freely upwards to the fire. The bars were of the same length as the grate, so as to extend from front to back. It would be perceived that the effect of this arrangement must be to screen the ash-pit completely from the heat radiated directly downwards from the grate, and so that scarcely any would pass through by reflexion. In fact, not a ray of heat could reach the ash-pit from the furnace without suffering four reflexions from rough iron surfaces, which would leave a mere shadow of a ray for further progress. Thus, a large quantity of heat which otherwise would be radiated out of the furnace into the ash-pit, thence reflected and so lost, was saved for the boiler. The ash-pit also was only slightly heated by the cinders which fell through: and this source of heat might be reduced to any extent by frequently removing the rubbish from the pit. Another consequence was, that the air passing from below through the grate, not being heated in the ash-pit, entered the fire cold, and therefore not—as it did from ordinary ash-pits—in a rarefied condition. By its coolness, this air prevented to some extent the burning of the grate-bars; and, by its unrarefied state it produced a more intense and rapid combustion of the fuel after it had passed the bars.

Another part of the contrivance was more especially the smoke-burning apparatus. It consisted of a set of tubes open at both ends, passing through the furnace horizontally from front to back, and terminating within the wall of the front of the bridge, with valves to regulate the access of air into the tubes. The fire-bridge differed importantly from that of an ordinary furnace: it was hollow, and was divided into two parts, the larger of which stood up from below; the other, which was shallower, was in contact with the boiler. Between them all the products of combustion passed from the furnace. The two parts communicated with each other by channels at the sides, and thus formed together an annular chamber. The tubes before mentioned entered the front wall of this chamber, and thus established a communication between its interior and the outer air. The back wall or plate, both of the upper and of the lower part of this chamber or bridge, being perforated with numerous holes, opening from the interior of the bridge to the space beyond it, established a direct communication between the outer air and the throat of the flue. There was a second solid bridge beyond the first, descending from the upper side of the flue; this, by interrupting the direct channel through that part of the passage, retarded the flow of the smoke and gases, and caused their perfect mixture with each other within the space between the bridges.

The result of this arrangement was, that a current of highly-heated

air which passed through the tubes in the furnace, escaped at the bridge through the perforations in the back wall, and, mixing with the gases from the furnace which held the smoke in suspension, converted the smoke into flame.

It was contended that, by the adaptation of this apparatus to marine boilers, the high temperature of the stoke holes and boiler-rooms would be obviated, and that the steam vessels would not be so evident from a distance as they now were by the volumes of smoke they gave out; and by having a telescopic sliding funnel, and substituting, during the period of being in action, a horizontal tube with a small fan-blower, any injury to the main funnel would be effectually prevented.

It appeared that the results of this apparatus had been very satisfactory; that at Messrs. Meux's brewery there was not the slightest appearance of opaque smoke from the chimney; and that the money-saving, resulting not only from the more perfect combustion of the fuel, but from the use of an inferior quality of coal at a lower price, amounted to full twenty per cent.

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November 21st, 1854.—The discussion was renewed on Mr. Woodcock's paper, "*On the Means of Avoiding Smoke from Boiler Furnaces;*" when it was shown, that although critically precise experiments for determining the amount of evaporation had not been previously made, there was no doubt of the fact of its being possible to use a lower-priced fuel, and to do the full amount of work with the boiler, without evolving any opaque smoke from the chimney; and thus, whilst complying with the requirements of the legislature, a pecuniary saving could be effected. Recently, however, by experiments on a cylindrical boiler, 17 feet long by 3 feet diameter, it had been shown, that $8\frac{9}{16}$ lbs. of water, injected at 42° Fahr., was evaporated by 1 lb. of Newcastle small coal, when Mr. Woodcock's apparatus was in use. It was found, that with small bituminous coal, a better evaporation was maintained than when Llangennoch coal was used, and without any appearance of smoke. The cast iron bridges of the furnace did not appear to suffer from the effects of the fire,—the passage of the air keeping the metal comparatively cool.

As soon as the valves of the apparatus at Messrs. Meux & Co.'s brewery were closed, there was a dense smoke; but on the instant of opening them, the heated gases combined with the oxygen of the air, and flashed into bright flame. Llangennoch coals had been generally used at Messrs. Meux & Co.'s brewery, not from any economy they offered, as they were not so strong as the Newcastle coals, but for the sake of the neighborhood, as they did not give out opaque smoke: however, with the apparatus described by Mr. Woodcock, small Newcastle slack could be used; and as it could be purchased at fourteen shillings per ton, whilst the Llangennoch coal cost twenty-eight shillings, there must be a money-saving, and the boilers worked quite as efficiently.

As to the general similitude between the principles advocated by Mr. C. Wye Williams and those brought into notice by Mr. Woodcock, almost the only difference appeared to be, that the former insisted on the necessity for the coldness of the air admitted, whilst the latter contended for the advantage of heating the air prior to its mingling with the gases.

On this point, many conflicting opinions were given, and examples quoted. It was, however, allowed, that the arrangement of the venetian blind screens below the grate bars, was novel, and was likely to be beneficial in preventing radiation into the ash pits, and thence into the boiler rooms of steam vessels; and there would not be any inconvenience from not being able to introduce prickers from beneath the bars, as good stokers always cleared the bars from above, by the use of the T head tool; and none but idle or bad stokers allowed the clinkers to accumulate, so as to run between the bars, and require the use of the pricker.

The use of heated air was practically contended for, because, when the air was admitted at a low temperature, there was a certain amount of loss from the chilling effect of the stream or film of air, before it mingled with the gases; whereas this effect was not perceived when the air was admitted at a certain temperature. Under Mr. Williams' system, this had been attempted to be provided against by multiplying the number and diminishing the individual area of the apertures for admitting air; but it was argued that, by extending the number of apertures still more, and previously raising the temperature of the entering air behind the bridge, the object would be more certainly attained. The system of supplying air at a very elevated temperature under gas retorts, had been very advantageously employed for many years, in conjunction with the hollow bridge originally introduced by Mr. Farey, the father of the late Mr. John Farey. (M. Inst. C. E.) In corroboration of these views, it was stated, that on board one of the "Citizen" steam-boats on the Thames, by a free admission of air, only through a series of parallel wire-gauze screens in the fire-door, so as to distribute it in minute jets, the exhibition of opaque smoke had been prevented,—whilst a saving of fuel was effected, without any loss of speed, or any extra labor to the stoker. A hollow bridge was also used; and a blast-pipe being extended from the base of the funnel, and opening into the bridge, further beneficial effect had been produced.

A model was exhibited of a hollow cast iron bridge-plate, with a series of vertical ribs, so arranged as to form tubes, leading up from the ash-pit to the apex of the bridge; where the air mingled with the heated gases, and passed away in flame. The currents of air up these bridge tubes preserved the iron from destruction, by carrying off the caloric, and it became heated in its upward course.

The introduction of cold air was advocated, on the ground that a mass of air, once broken up into films, or minute jets, would not again unite, but that each particle would pursue its independent course, until it combined with the heated gases. Therefore, the system of admission by the perforated fire-door, so as to pass over the incandescent fuel, had been so strongly advocated.

It was urged, that mechanical or other means should be adopted for regulating the proportion of oxygen, according to the state of incandescence of the fuel on the bars. This, it was contended, was virtually accomplished through the side tubes of Mr. Woodcock's apparatus; as it had been shown, that the velocity of the passage of air through the tubes, was exactly in proportion with the demand for oxygen by the fuel. That the air was really heated in its passage has been shown by insert-

ing a thermometer, protected from radiated heat, into a flue in connexion with the hollow bridge.

The question of the applicability of most of the systems of preventing the exhibition of opaque smoke, was shown to depend, to a great extent, on the area of the fire-grate and the size of the boiler; for if both were restricted, so as to demand an excessively rapid draft, there could not be a sufficient mingling of the gases to insure perfect combustion.

Proceed. Inst. of Civ. Engin.

For the Journal of the Franklin Institute.

Notice of a new Cast Iron Foot Pavement. By FAIRMAN ROGERS, Civ. Eng.

There is now in the course of construction, at the new iron building of Frederick Brown, Esq., Fifth and Chestnut Streets, a new cast iron foot pavement, designed by Mr. B. Severson, Superintendent of J. A. Gendell's Architectural Iron Works, in West Philadelphia.

A small pavement of iron was put down by the same firm a few months ago, at No 58 Chestnut Street. But in the specimen now under consideration, the principle has been carried out to a much greater extent, and the work is of considerable magnitude.

The pavement is made of cast iron plates, 12 feet long, 3 feet 4 inches wide, and $\frac{5}{8}$-inch thick; 12 feet being the width of the pavement from the building to the curb. These plates are roughened on the surface by grooves $1\frac{1}{4}$ inch apart, crossing each other at an oblique angle, so as to divide the surface into diamonds.

A cast iron $\frac{1}{2}$-inch plate, with its two edges turned at a right angle, so as to make flanges at the top and bottom, forming a girder 11 inches deep, is bolted to the columns of the building, making a support on which the inner ends of the plates rest. The curb is of cast iron, $\frac{1}{2}$-inch thick, 11 inches deep, having a flange on *each* side, at the *bottom*, and on the *inside* only at the top; it is made to slope slightly outwards from the top to the bottom.

Scale ¼ inch to the Foot.

This curb rests upon a brick wall, forming the outside wall of the cellar, a good cement being interposed to make a water-tight joint; the pieces of curb have butt joints secured by a cast plate behind, riveted securely to both pieces, cement being interposed. From the building gir-

der to the curb, and resting on the lower flange of each, stretch girders or joists, 12 feet long and 11 inches deep, 3 feet 4 inches apart, on which the pavement plates are laid and securely fastened by bolts or rivets, with counter sunk heads, going through the flanges of the girder, the joists, and the curb.

All the joints are carefully cemented so as to be water-tight; the transverse girders or joists are of ½-inch cast iron, strengthened on the bottom flange by wrought iron flat bars, bolted to the cast iron only at the two ends, and slightly expanded by heating when it is put on, so as to bring the lower part of the girder into a state of compression.

The brick or stone of the gutter, is to be laid upon the outer flange of the curb.

Some of the plates have a circular hole left in them, about 18 inches in diameter, for the reception of the ordinary gratings, for ventilation or access, or of glass *lights*. The glass is cast into its cast iron circular frame, thus forming a strong water-proof joint, the ring being heated before casting the glass in it.

The cost of this pavement, when iron is $35 per ton, is $1·75 per square foot of surface; this includes curb and laying. If the plates are more than 12 feet long, the cost is somewhat increased per square foot, from the greater trouble in casting.

The pavement on Fifth Street is 90 feet long, and that on Chestnut will extend the whole front of the building, a fine airy cellar being left under it, which being partially warmed in winter by the heaters for the building, will melt the snow falling upon the pavement.

The small pavement mentioned above, has been laid down for several months, and appears to answer its purpose very well.

This is the first iron pavement of any size yet laid in Philadelphia, and it seems to promise very great efficiency and convenience; the great ease of removal, in case of repairs, or for any purpose, is certainly a great recommendation.

For the Journal of the Franklin Institute.

On Caustic Lime in Blast Furnaces. By William Truran, Esq.

Caustic lime is now partially employed at several works in Wales and other iron-making districts in Europe, as a substitute for the raw limestone commonly used as a flux in blast furnaces. Although the advantages which are found to attend its application have not fully realized the sanguine expectations of furnace proprietors, they have sufficed to show, that its application is attended with some important results to the metal produced from the blast furnace.

The motives which induced iron masters to try the effects of burnt lime as a flux, appear to have been a desire to augment the production of metal from the blast furnace, conjointly with a diminution of the expenses attendant on the smelting operation. This, it was confidently anticipated, would follow on the substitution of lime, for the carbonate of lime hitherto used. Calculations based on the composition of the gases at different altitudes in the furnace, pointed out the carbonate

of lime as exercising a prejudical effect on the working of the furnace. It was believed that the absorption of caloric by the carbonic acid of the limestone in its passage from the solid to the gaseous state in the blast furnace, would no longer take place, and that the reduction in the furnace fuel would more than compensate for that used in the lime kiln.

It was also believed, that by calcining the limestone previous to its introduction into the blast furnace, the cooling influence which is occasioned in the upper regions of the furnace by its introduction in the raw state would be avoided, and as this increase of temperature over that usually obtained would be equivalent to an increase in the altitude of the furnace, a corresponding augmentation of the usual weekly make of the furnace would result from the altered mode of filling the lime.

Theoretically, a considerable saving is effected by the use of caustic lime, but practically, there is little or none. At works where limestone is filled into the furnace without having been broken into suitable lumps, the reduction in the consumption of the limestone and fuel by the use of caustic lime may be considerable, but where it has been usual to break the limestone into pieces, not weighing more than a few ounces, the diminution is almost inappreciable. Large masses of limestone require a correspondingly longer time for their complete calcination, and while this is being effected, they descend into the furnace along with the ore and fuel, until they have absorbed from the latter the caloric necessary for their complete decomposition. The depth at which this is effected, will depend on the size of the stones used. The larger these are when filled, the deeper will they descend into the furnace before complete decomposition. In those furnaces which are supplied with finely broken limestone, the lumps, from their small bulk, quickly absorb the requisite caloric, and are afterwards in their further descent distributed through the burning materials. The caloric which they absorb during their conversion, is collectively the same as that absorbed by the coarsely broken limestone, but with this difference, that it is absorbed in the upper regions of the furnace; where, if the furnace has been fed with raw bituminous coal, as fuel, the heat is at all times sufficient for the purpose, and can be spared without sensibly impairing the efficiency of the furnace. The calcination or decomposition of the limestone is effected by a certain determinate quantity of fuel, and this will be the same, whether the operation be conducted in the mouth of the blast furnace, or in an independent furnace, so long as it be accomplished before the materials in the furnace have reached the region of the boshes.

At Merthyr Tydfil, the first experimental application of caustic lime was made in a blast furnace, 50 feet high, and 18 feet in its largest diameter. The charge before alteration averaged about 18 cwts. of calcined clay ironstone, 18 cwts. of forge cinders, and 9·5 cwts. of coarsely broken limestone to the ton of coal consumed. With this burden, the make for a period of six months preceding the experiment, averaged 108 tons of forge pig iron weekly. The burden was altered to 18 cwts. of calcined clay ironstone, 18 cwts. of forge cinders, and 6 cwts. of burnt lime to each ton of coal, when the weekly make for the first three months of the experiment averaged 114 tons.

From this experiment it would appear that the application of burnt

instead of raw limestone, was attended with an augmentation of the weekly make of iron equal to 5 per cent. on the make for the preceding six months. On going further back, however, it was found that the average weekly make of the furnace for the preceding three years, was 116 tons. It is, therefore, questionable if the augmentation was solely the effect of the calcination of the limestone.

But, although the augmentation in the make may have resulted from other causes than the use of burnt lime, there appears no reason for doubting its connexion with an improvement observed in the quality of the iron produced. This was decidedly superior to the iron previously made, where softness and ductility were required. Its conversion, however, into refined metal, required more than the usual blowing, and its refractory disposition was still further manifested in the puddling forge, where its conversion into puddled iron was attended with some difficulty.

The consumption of fuel in the blast furnace with the limestone flux, amounted to 38 cwts. on the ton of pig metal produced; with burnt lime it was 36·5 cwts. to the ton, showing a difference of about 4 per cent. in favor of the burnt lime. But, owing to the extra blowing in the refinery and the difficulties encountered in the puddling forge, the additional fuel consumed in these operations, amounting to 3·5 cwts. on the ton of puddled iron, leaves a balance of 2 cwts. in favor of the limestone flux.

In consequence of the curious and very important experiments on Phonic Signals recorded by Mr. Cresson in the Number for December, 1854, we take from the pages of the *London Illustrated News*, 1844, the following description of a very neat, compact, and, we do not doubt, efficient instrument for producing sounds, when a steam whistle cannot be used. EDITOR.

The Telephone, a Telegraphic Alarm.

Amongst the many valuable inventions recently laid before the Lords of the Admiralty, that of the "Telephone, or Marine Alarm and Signal Trumpet," by Captain J. N. Taylor, R. N., is, perhaps, one of the most important; its objects being to convey sound signals to vessels at sea, or in harbor; to transmit orders to and from forts and ships; to prevent collisions at sea, or on railroads; to transmit orders on the field of battle, from position to position, as an auxiliary to the duties of the aide-de-camp, or orderly, who frequently rides with important despatches in the face of an enemy in great haste and imminent risk; to inform engine stations in case of fire; for alarms in dock-yards, &c.; and as a means of communication between the palaces and halls of the nobility and gentry, &c.

The principle of the Telephone is one of musical accord, composed of four alternate notes, given out separately, played like those of the cornet, and prolonged whilst the finger remains on the note. The instrument is formed of a chamber, into which air is compressed through three or more alternate pumps, which are moved by a corresponding number of cranks, set in motion by a winch; and of a set of piston keys, with valved apertures, giving free egress to the compressed air, which, in its passage, acts upon a series of metallic springs, and produces the required sounds through four pipes or trumpets.

The Indicator.—The Indicator, or Signal Tell-Tale, to be placed on the Telephone Drum, to denote the signals made, is composed of 16 holes, in four parallel lines, and numbered at the top 1, 2, 3, 4. The first number made is to be indicated by a peg, placed under the required figure, in the first horizontal column, colored red; the second number in the white; the third in the blue; and the fourth in the yellow line, observing that only one peg is to be placed in the same horizontal row of holes. The Telephone gamut notes are arranged for numbers either by the public or private key. The alternate notes of the gamut C, E, G, C, being denoted by 1, 2, 3, 4.

The Telephone Gamut.—The Telephone, No. 1, will convey signals four or five miles; and as a fleet sailing in three columns will not extend over more than three miles, it will be sufficient for the guidance of the whole fleet, in foggy weather, by night or day. For fixed stations, light-vessels, light-houses, preventive ports, &c., it is made the size of a large drum, with trumpet in accordance, and will convey signals in foggy weather six or eight miles; or by unscrewing the trumpet, and applying a parabolic phonic reflector to it, the sound will be conveyed to a much greater distance.

Ships or steamers passing each other, by giving the signals for "helm to port," &c., &c., would prevent those dreadful collisions and loss of life which frequently occur, either from indecision, the thickness of the fog, or other causes.

As an alarm-instrument, to be used on light-vessels, light-houses, dangerous headlands, &c., the Telephone is most important, as it will be the means of preventing the great sacrifice of life and property, which so frequently takes place in foggy weather, from the lights being invisible. Vessels would also be directed by it to the pier or harbor, and the height of the tide for entering conveyed to those in the offing. On railroads, too, it is of great importance, as an instant signal for stopping the train, increasing the speed, or of the approach of another engine, may be given from the guard to the engineer.

Another advantage of the above instrument is, that it can be employed with a secret key, so that two persons in correspondence will understand the communication, while it remains unintelligible to others.

AMERICAN PATENTS.

List of American Patents which issued from November 14, to December 12, 1854, (inclusive,) with Exemplifications.

NOVEMBER 14.

38. For an *Improvement in Machinery for Carving Stone;* Edwin Allen, South Windham, Connecticut.

Claim.—"I claim the employment of two pantographs, combined with a tracer and cutting tool, to wit: the pantographs being arranged at right angles to each other, and having their main pivots connected or arranged in such a way as to form an universal joint, and the tool and tracer being suspended from or attached to the pantograph, and passing through sockets in the legs of the pantograph, whereby the tracer and tool are allowed an universal movement."

39. For an *Improvement in Smut Machines;* Levi B. Ball, Putnam, Ohio.

Claim.—"I claim the employment of wood and iron slats, placed alternately, or of any other hard and soft substances, arranged in an equivalent manner, and producing a similar effect."

40. For an *Improvement in Cultivators;* William Bancroft, Whiteford, Ohio.

Claim.—"I claim the method of making the knife adjustable upon the frame, by means of a standard and hinged standards."

41. For an *Improvement in Side Valves for the Exhaust Steam;* Henry Bates, New London, Connecticut.

Claim.—"I claim the employment, in combination with the usual slide valve, of a supplemental exhaust slide valve, to be operated by a separate mechanism, to work over a separate series of ports, which are similarly arranged to and communicate with the same passages as the usual ports, for the purpose of giving a free exhaust, till the termination of the stroke of the piston, and for enlarging the area of passage for the exhaust."

42. For an *Improvement in Double Cylinder Boilers for Hot Water Apparatus;* Wm. Beebe, City of New York.

Claim.—"I claim the combination of two boilers, one within the other, and two reservoirs, one above the other, arranged, with one set of connexions, with a kitchen range, so that the upper part of a house may be supplied with hot water, by means of the upper reservoir, which will derive its supply of cold water either from the roof or from a force pump, while the lower part of the house will be supplied by means of the lower reservoir, which will derive its supply from the public water works."

43. For an *Improvement in Furnaces for Making Iron Direct from the Ore;* Martin Bell, Sabbath Rest, and Edward B. Isett, Spring Forge, Tyrone City, Penna.

Claim.—"We claim the series of inclined close deoxydizing tubes or vessels, built of common fire-bricks, and arranged so as to be parallel or nearly so with each other, and inclined at an angle of about fifty degrees from the horizon, so as to lie or rest their whole length securely upon a substantial inclined base, and also so as to be exposed only on the two opposite outer sides of each tube, to the action of the escaping heat from the furnace as it passes along through the intermediate flues, the same being combined with the main flue through the opening, and with the interior of the furnace, each ore tube having an adjustable cut-off or sliding gate at its lower end, and also combined with a separate horizontal way, as described, leading directly into and connecting the said tubes with the bottom of the reverberatory furnace."

44. For an *Improvement in Lamp Caps;* William Bell, Boston, Massachusetts.

Claim.—"I claim the perforation in the lamp cap, in combination with the short chamber of perforated tin, wire-gauze, or other analogous contrivance, by which means the lamp may be filled without removing the cap, and the spirit within the lamp may be protected from igniting, when the lamp is filled, without the use of the double cylinder of wire-gauze or perforated sheet metal, as heretofore employed."

45. For an *Improvement in Cultivators;* Job Brown, Lawn Ridge, Illinois.

Claim.—"I claim the combination of the angular-shaped frame (having the two pieces united at their forward ends into a tongue,) with the long standards and short standards."

46. For an *Improved Device for Adjusting Mill Saws;* T. M. Chapman, Oldtown, Me.

Claim.—"I claim the stocks secured to the upper and lower cross-pieces of the gate or sash, the stocks having a belt or stop at each end."

47. For a *Multigardo Iron Fence;* Matthias P. Coons, Brooklyn, New York.

Claim.—"I claim the combination of the devices, the form of mortise in picket, and the collar and sheave."

48. For an *Improved Mode of Adjusting Vessels upon the Keel Blocks of Dry, Sectional, or Railway Docks;* Horace J. Crandall, East Boston, Massachusetts.

Claim.—"I claim the manner in which the materials, that is to say, the hollow tube, screw, pawl ratchet slide, and bearer, are arranged, for the purpose of holding the keel in the required place."

49. For an *Improvement in Looms for Weaving Figured Fabrics;* George Crompton, Worcester, Massachusetts.

Claim.—"I claim arranging two or more patterns upon a single chain, so that by bringing the rod of the chain into operation in a certain order, one pattern is produced, and by operating them in different order, another pattern is produced. 2d, Placing two or more patterns upon the rods of a pattern chain, side by side, and operating them in succession, by vibrating the chain laterally. 3d, Pivoting the lifting and depressing rods at one end, the other end being made adjustable.

50. For an *Improvement in Sewing Machines;* Daniel Harris, Assignor to John P. Bowker, Boston, Massachusetts.

Claim.—"I claim the so arranging the bent arm, that by its movement it shall perform the triple operation of slacking up the thread as the needle is about penetrating the cloth, and admit of the necessary pause whilst the shuttle passes through the loop, and then tighten up the stitch in advance of the upward motion of the needle bar, and draw from the spool the requisite amount of thread for the next stitch."

51. For an *Improvement in Ploughs;* Jonathan Hibbs, Tullytown, Pennsylvania.

Claim.—"I claim combining with a plough the revolving weed-clearing rollers, armed with spikes, said rollers being operated automatically by a wheel attached to the back part of the plough."

52. For an *Improved Paging Machine;* George Hodgkinson, Cincinnati, Ohio.

Claim.—"I claim, 1st, The construction and combination of the pair of taking-up wheels, weighted double acting tension cord, and type bearer, in combination with the square shaft and trigger, and actuating piston, or equivalent devices, for the proper tension and delivery of the type bearer, during the alternate advancement and impression of the type. 2d, The series of type blocks, consisting, each in succession, of the consecutive odd number, coupled with the even number three units higher in the scale, in combination with an extended platen, and its accessories, or equivalent devices, so as to act at each stroke upon the further pages of two consecutive leaves of an unfolded or open book. 3d, The mode of clamping the type blocks to the band by means of a sheet metal shaft enclosing the rear, side, and edges of the type holders."

53. For an *Improvement in the Method of Engaging and Disengaging Self-Acting Car Brakes;* George T. Leach, Boston, Massachusetts.

Claim.—"I claim the combination of the two jointed pawl levers, the socket shaft and its lever workers, and the two racks, as arranged and applied to the bunter bar and the brake."

54. For an *Improvement in Breech Loading Fire Arms;* F. Maton, City of N. York.

Claim.—"I claim the combination of a sliding breech piece, having a semi-spherical socket, and a partially rotating motion whilst closing on the end of the barrel, with a fixed barrel having a corresponding semi-spherical end, the two forming a cap and ball joint, whereby the powder is brought nearer to the point at which the cap is exploded, a more certain ignition attained, and the joint between the breech and the barrel more effectually closed. Also, the employment, for the front sight of a fire arm, of a needle wire, or its equivalent, having a bulge or enlargement at or near its middle, which is in a horizontal position when the arm is leveled for firing."

55. For an *Improvement in Omnibus Registers;* Wm. Morris, Philadelphia, Penna.

Claim.—"I claim forming a notch near the end of the bell hammer bar, annexed to the toothed bar, so as to cause the same to act as a double pawl or stop on the teeth of said wheel, and prevent a recoil of the same, when the spring bolt and cog have not been drawn sufficiently high to strike the bell and record a fare, and the consequent striking of the bell by the pawl, and of the bar being allowed to move quickly upward upon said recoil."

56. For an *Improvement in Railroad Car Coupling;* Joseph Miller, Orleans, N. York.

Claim.—"I claim the combination of the horizontal acting hook with the vertically moving box."

57. For an *Improvement in Grain Winnowers;* Wm. Moore, Belleville, Ohio.

Claim.—"I claim the arrangement of riddles around a perpendicular fan, so that

grain can pass over each, and be acted upon at any desired point, by wind from said fan."

58. For a *Tape Worm Trap;* Alpheus Myers, M. D., Logansport, Indiana.

Claim.—"I claim a trap for the removal of tape worms from the stomach and intestines, which consists of a trap which is baited, attached to a string and swallowed by the patient after a fast of suitable duration to make the worm hungry. The worm seizes the bait, and its head is caught in the trap, which is then withdrawn from the patient's stomach by the string which has been left hanging from the mouth, dragging after it the whole length of the worm."

59. For *Tape Worm Operation;* Alpheus Myers, M. D., Logansport, Indiana.

Claim.—"I claim the process of removing tape or other worms from the stomach or intestines, by means of a trap, which is baited and swallowed by the patient, and is caused to capture them by the seizure of the bait."

60. For an *Improved Mode of Guiding and Controlling Logs in Saw Mills without a Carriage;* C. B. Normand, Havre, France; patented in England, Oct. 27, 1852; patented in France, Nov. 5, 1852.

Claim.—"I claim the employment of a longitudinal bar above the log, the lower edge of which bar is made sharp or angular, to indent the prominent part or parts of the log, and the said bar being parallel with the line of the intended cut, and movable vertically to suit logs of various sizes. Also, in combination with the bar for controlling and guiding the upper edge of the log, the employment of a like bar on which the log rests and moves."

61. For an *Improved Method of Hanging Saws for Mills;* C. B. Normand, Havre, France.

Claim.—"I claim connecting the saw gate, in which the saws are strained, with the outer ends of two vibrating beams, one at each end, and giving to the saw or saws. Also, composing the ways for the carriage of a series of cylindrical rollers, which can be shifted to variable heights, so that the upper part of their peripheries can be set to coincide with a flat plane, or arcs of circles of large radius, in combination with the flexible carriage, which can be bent to the shape of the intended cut, as determined by the set of rollers composing the ways."

62. For an *Improved Method of Controlling the Log for Curved and Bevel Sawing;* C. B. Normand, Havre, France; patented in England, Oct. 27, 1852; patented in France, November 5, 1852.

Claim.—"I claim the mode of operation for directing the log or timber to the saw or saws, in curvilinear sawing, by means of rollers, or their equivalents, whose axes can be shifted at pleasure to determine and vary the line of motion of the log or timber to the saw or saws, without the necessity of turning or moving the saw or saws laterally. Also, mounting the rollers, which support the log or timber to be sawed, in a sawing or vibrating frame, or the equivalent therefor, so that the plane tangent to the upper edges of the rollers can be placed at any desired angle with the plane of motion of the saw, and there retained or gradually shifted in either direction during the sawing operation, whereby the log or timber can be sawed to any fixed and determined level, or to any level varying in any desired degree."

63. For an *Improvement in India Rubber Overshoes;* J. A. Pease, City of N. York.

Claim.—"I claim making india rubber or gum shoes with the inner surfaces rubbed, corrugated, or otherwise made uneven, for the purpose of allowing a circulation of air between it and the boot or shoe over which it is worn."

64. For an *Improved Excavator and Ditching Plough;* Chas. A. Robbins, Iowa City, Iowa.

Claim.—"I claim the employment of the vertical reciprocating cutter arranged for the purpose of cutting the earth into sods or pieces, for the purpose of rendering the earth easy of removal, either by hand or by endless aprons."

65. For an *Improved Excavating Machine;* George D. Stillson, Rochester, N. Y.

Claim.—"I claim, 1st, The controlling of the cutting edge of the excavator, so as to keep it always at or about the same relative position in regard to the earth to be removed,

and yet admit of being raised or lowered to ease said cutting edge when too powerfully resisted, and thus materially aid the scraper in entering and passing through the earth to be removed. Also, the so hanging of the scraper to the frame which supports it, by means of pivoted radial arms or braces, so that said scraper, and the earth thereon, may, by the turning of a hand wheel, or other equivalent device, be first raised up horizontally, or nearly so, a sufficient distance to admit of its being drawn away, and then by continuing to turn said hand wheel, or other raising power, to gradually tilt and dump the scraper. Also, the hanging of the scraper to the frame or truck, by means of rigid arms, so as to employ the entire weight of the carriage and load upon it, in holding the scraper to its work. Also, the use of a breaker, substantially such as described, placed at or near the front of the scraper, for the purpose of loosening up the earth, and facilitating its progress to the rear of the scraper, and to prevent packing or clogging in the front of the scraper."

66. For a *Shingle Machine;* William Stoddard, Lowell, Massachusetts.

Claim.—"I claim, 1st, The riving knife, in combination with the sliding cap. 2d, The spring stop. 3d, The jaws, or their mechanical equivalents."

67. For an *Improvement in Grain and Grass Harvesters;* J. Swartz, Buffalo, N. Y.

Claim.—"I claim the application to the driving or vibrating of the cutter bar of the crank, pitman toggle levers, hinged lever, and rod, for the purpose of giving four reciprocating motions to the cutter bar for every revolution of the crank shaft. Also, so hanging the cutter and guard tooth bar to the machine, by means of the hinged pieces, as that it may rise and fall in parallel lines, whether used for cutting grain or grass."

68. For an *Improvement in Machinery for Stretching and Drying Cloth;* Benjamin J. Tayman, Philadelphia, Pennsylvania.

Claim.—"I claim, 1st, The means for stretching the cloth while wet, and carrying the same parallel while being dried, consisting of the endless belts of tenter hooks traveling on adjustable guides or ways to accommodate different widths of cloth, which ways are parallel to each other, except at the ends where they converge, to allow the cloth to be hooked on, and stretch the same as it is moved forward. 2d, The application of sponge and fan brushes, in combination with the drying cylinder, to hasten the process of drying the cloth."

69. For a *Saw Gauge;* Orson Westgate, Riceville, Pennsylvania.

Claim.—"I claim the construction of the bed piece with the cog racks, in connexion with the cog wheels, and the brakes pressed upon the said cog wheels by means of the spring."

70. For an *Improved Method of Constructing Printing Blocks;* Leon Jarosson, Jersey City, New Jersey.

Claim.—"1st, Cutting the several parts of the design, or the design and ground, the one out of the other, from a plate or sheet of prepared felt, wood, or other suitable substance, of the thickness of the required relief, and then securing the parts to the surface of blocks by means of cement, glue, or other suitable means, by means of which I am enabled greatly to reduce the cost of producing the printing blocks, for by the one act of cutting I produce two printing surfaces to print with different colors, and in that proportion whatever may be the number of colors of the intended design, and by which, also, I insure the exact fit of the several blocks for printing the several colors."

71. For an *Improvement in Casting Type;* George Bruce, City of New York.

Claim.—"I claim the application of an artificial blast to cool the type mould, or prevent it from overheating in casting, by which printing types can be cast much more rapidly than ever before."

72. For an *Improvement in Rollers for Pattern Chains for Looms;* Geo. Crompton and M. A. Furbush, Worcester, Massachusetts.

Claim.—"We claim a wrought iron tube, made use of for the bearing of the roller, the body of the roller being secured thereto by casting, in the manner set forth, whereby the rollers, when strung upon the chains, are caused to fall into the exact position required to operate the crooked jacks, without the necessity of gearing and turning down the roller, as has heretofore been done."

73. For an *Improved Arrangement in Lever and Catch for Tow Lines of Canal Boats;* J. W. Cadwell, Rochester, New York.

Claim.—"I claim my arrangement of the frame, the tumbler, and the lever, with the ring and spring."

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74. For an *Improved Arrangement of Means for Lubricating the Cylinders of Steam Engines;* John Absterdam, Boston, Massachusetts.

Claim.—"I claim placing the lubricating reservoir remote from the boiler, and interposing between the oil and the boiler, water, air, or other substances which will communicate the pressure from the boiler to the oil, and thus keep the oil from being heated, and yet feeding it to the surface to be lubricated by the pressure from the boiler."

75. For an *Improvement in Hand Brick Moulds;* Clark Alvord, Syracuse, New York.

Claim.—"I claim the application of the discharging piston to the hand mould."

76. For a *Machine for Papering Walls;* Henry F. Baker, Centreville, Indiana.

Claim.—"I claim the manner in which I arrange and combine the cylinders, rollers, and side bars, for the purpose of pressing the paper to the uneven surfaces of the wall, and at the same time press all the air from between the paper and the wall, thereby causing the paper to be laid on smooth, nicely, and evenly, without hand labor."

77. For an *Improvement in Sauce Pans;* Henry F. David, Ipava, Illinois.

Claim.—"I claim my improved manner of opening and closing the cover of a sauce pan or stew pan, and of retaining the same in an open position, viz: by means of the combination of said cover with the rod which passes through the hollow handle of the pan, and is supplied with a spring catch."

78. For *Improvements in Machines for Closing Sheet Metal Boxes;* Chas. G. Everitt, Brooklyn, New York.

Claim.—"I claim, 1st, The arrangement of the driving shaft and upper roller shaft with the adjustable sliding boxes, springs, and treadle, in relation to the lower shaft and frame of the machine, for the ready adjustment and adaptation of other roller heads, and for the putting in and taking out of the sheet metal articles being made. 2d, I claim the arrangement of the adjustable spring frame, with its adjustable friction rollers, and in relation to the roller heads, for the purpose of guiding and sustaining the sheet metal pieces of various shapes and of different widths."

79. For an *Improvement in Valve Gear for Locomotive Engines;* James Freeland, Alleghany, Pennsylvania.

Claim.—"I claim the employment, for the purpose of transmitting motion from the eccentric, or its equivalent, to the slide valve of a rock shaft carrying the eccentric arm which is connected with the valve arm on the usual valve shaft, by means of a connecting lever, an arc formed slat, a rocker, and links, all arranged to give the valve the whole, or the greater part of its movement, during a comparatively small portion of the revolution of the eccentric, or its equivalent."

80. For an *Improvement in Cleaning Cards of Carding Engines;* Samuel Greene, Woonsocket, Rhode Island.

Claim.—"I claim the application of the clearer cylinder and wiper, by which the impurities of the cotton are taken out and formed into a bat."

81. For a *Shingle Machine;* Adoniram Kendall, Cleveland, Ohio.

Claim.—"I claim, 1st, The hopper, slide catch, and slide rests, with the attachment of the spiral springs, and elliptic springs; this combination I claim separately and combined with the driver. 2d, The combination of the sliding key, strap, cross-piece, and spring, for the purpose of holding the shingle while it is being squared by the fingers. 3d, The levers, tumbler, fingers, slide, and spring, operating by means of the grooves and cams, for the purpose of squaring the shingle by the fingers, so that the edges will be jointed square with the butt. 4th, The circular grooved cams, in combination with the levers, connecting rod, spring, right angled levers, and adjustable knife blocks, I claim either separately, or in combination with the guides and levers. 5th, I claim, also, the combination of the reciprocating carriage with the driver."

82. For an *Improvement in Kettles for Calcining Plaster of Paris;* Jerome B. King, City of New York.

Claim.—"I claim the method of fitting a conical or arched bottom to kettles for calcining plaster, so that the same shall be allowed to slide on its bearings as it expands and contracts."

83. For an *Improvement in Seed Planters;* George W. Lee, Ercildown, Penna.

Claim.—"I claim the scores, or their equivalents, at the extremities of the holes in the disks, in combination with the gradual narrowing of the holes towards their extremities, so as to save the grain from being cut between the ends of the hole, *c*, and the edges of the hole, *b*. I claim the shape or form of the end of the hole in the disk."

84. For an *Improvement in Packing Slide Valves in Steam Engines;* Dan. B. Martin, Washington, New Jersey.

Claim.—"I claim the mode of packing balanced slide valves, the same consisting in the attachment of the packing to the bonnet of the steam chest, whereby I am enabled to adjust the packing while the engine is in motion."

85. For an *Improved Mode of Attaching Life Preservers to Vests;* Richard L. Nelson, Ocala, Florida.

Claim.—"I claim the method of arranging a removable life preserver in a vest or other garment, so that it may be worn with or without it, and so that the fastenings of the garment shall serve to secure the life preserver properly to the person."

86. For an *Improvement in the Arrangement of Pencils for Drawing Machines;* Mighill Nutting, Portland, Maine.

Claim.—"I claim supporting a pencil by a tube, so that spiral springs may be made to operate in pressing the pencil downwards, upwards, or both upwards and downwards, when desirable; the apparatus thus arranged may be supported in a movable frame."

87. For an *Improvement in Sewing Machines;* C. Parham, Philadelphia, Penna.

Claim.—"I claim the shuttle carrier and driver, forming the bearing or seat for the shuttle during its travel, as well as the guide for it on that side coming in contact with the thread loop formed by the needle, and freely admitting of the passage of the shuttle through the loop, when the said carrier is arranged and combined for operation, together with the needle and with the guide plate, or its equivalent, on the needle side of the shuttle, whereby the shuttle is relieved from all friction or rubbing bearing on its thread side of the loop, the thread is prevented from being soiled or injured by lubricating material, and increased freedom of action is given to the shuttle."

88. For an *Improvement in Spinning Frames;* Wm. Perry, Graniteville, S. C.

Claim.—"I claim a movable band or bands, whether made endless or otherwise, of cloth or some other material, so constructed that it may be traversed upon the bobbin rail, under the bobbins, each side, or between the spindles, to graduate the friction under the bobbins, and adjust the drag of the bobbin to suit the yarn being spun upon the frame."

89. For an *Improvement in Manufacturing Wire Rope;* J. A. Roebling, Trenton, N. J.

Claim.—"I claim, 1st, Operating the top wagon by the same driving rope which operates the twisting machines, for the purpose of regulating the advance of the top in proportion to the twist. 2d, The propulsion and operation of the centre strand counter twist machine, by the same driving rope which actuates the main twist machine, for the purpose of insuring a perfect correspondence between the motion of the two machines, and at the same time to insure the proper tension of the centre strand by keeping it exposed to the action of a freely suspended weight. 3d, The combination of the two sheaves with the hollow shaft for operating the endless rope, and to operate the main counter twist machine. 4th, The whole arrangement for operating the main counter twist machine, by means of an endless driving rope, which is kept under a great tension by a suspended weight, and being at liberty to rise, allows the machine to advance as the strands shorten, and at the same time insures a constant and uniform tension. 5th, The peculiar arrangement for lowering the weight box, without slackening the driving rope, by the application of a break friction wheel and check wire, in connexion with a windlass and spur gearing, or the mechanical equivalent therefor, and in combination with the sled and transfer sheave."

90. For an *Improvement in Machines for Threading Screw Blanks;* Elliot Savage, Berlin, Connecticut.

Claim.—"I claim the manner in which the screw blank rest or carriage is moved, in order to form a conical or approximately conical or tapering end to the tail part of the screw blank, in connexion with a cylindrical body and a helix or screw thread thereon, such movement consisting in turning the screw blank with respect to the chaser, and subsequently causing it to descend in a vertical line."

91. For an *Improvement in Furnaces;* J. L. Stevens, Kennington, England; patented in England, Oct 1st, 1852.

Claim.—"I claim supplying the lower fire bars with ignited fuel from the upper bars. Also, the combination of the double fire bars with the plate, for dividing first and then uniting the gases of each, when said fire bars are fed with fuel through one door, and have a fire bridge which is common to both."

92. For an *Improvement in Inhaling Apparatus;* S. H. T. Tilghman, Snow Hill, Md.

Claim.—"I claim the combination of worm tubes, mouth piece, bellows, and distilling vessel, for furnishing medicated air in a comparatively dry state, and assisting the respiration of the patient in inhaling it."

93. For an *Improvement in Clothes Clamp;* Wm. H. Towers, Philadelphia, Penna.

Claim.—"I claim securing clothes or other articles on lines, by impinging or pressing them between the line and the grooved ends of the clamp or button, having a block at its centre through which the line passes out of its usual line."

94. For an *Improvement in Dressing Mill Stones;* T. W. Trussell, Winchester, Va.

Claim.—"I claim the rounding off and polishing the feather edge, or sharp cutting ridge lines of mill stones, and reducing all the intervening burr or granulated face to a smooth surface."

95. For an *Improvement in Lamps;* Isaac Van Bunschoten, City of New York.

Claim.—"I claim the means of confining a thick solar or Argand wick to the metallic wick holder by a finely wove wick or covering. I claim the cone, *d*, in combination with the cone, *e*, and circular plate around the wick tube, to check any sudden draft, and prevent the same passing to the flame."

96. For an *Improvement in Seed Planters;* Milan Waterbury, Cuba, New York.

Claim.—"I claim, in combination with the cap or scroll, the peculiar form of the cells, that is to say, the receiving of the grain into the shallow part of the cell, from whence it gradually shifts into the deeper part thereof, and kept from falling out of the cells by the cap or scroll, by which means the packing or choking of the grain in the cells is entirely avoided."

97. For an *Improvement in Hemp Rotting Processes;* William Watt, Glasgow, North Britain; patented in England, May 22, 1852.

Claim.—"I claim the application to flax, straw, and similar vegetable fibrous substances, of a current of steam and hot water, or hot water alone, at a temperature of not less than one hundred and fifty degrees of Fahrenheit's thermometer, for the purpose of carrying off the volatile matters of such substances, and dissolving and removing their nitrogenous and other extractive matters, without the aid of fermentation, acids, or alkalies."

98. For an *Improvement in Surgical Forceps;* Mary Ann Loomis, Executrix of Jos. G. Loomis, dec'd., Assignor to Wm. A. Gardiner, Philadelphia, Penn.

Claim.—"I claim the improved rotary joint, by means of which the instrument may be introduced with one scoop and blade resting within the other, and the instrument then rotated and opened for operation."

99. For an *Improvement in Scythe Fastenings;* Thos. C. Ball, Assignor to Nathaniel Dawson, Shelbum Falls, Massachusetts.

Claim.—"I claim the slide with its fulcrums and its corresponding recess, in connexion with the leverage of the shank."

100. For a *Presser Bar for Planing Machines;* Harvey Snow, Dubuque, Iowa, Assignor to James A. Woodbury, Winchester, Massachusetts.

Claim.—"I claim combining the presser bar with the rotary cutters, so as to secure the same relative position of the inner edge of the bar and the path of the cutting edge in holding and cutting the surface of a board throughout its varying thickness."

101. For an *Improvement in Apparatus for Drying Clothes;* Stephen Woodward, Assignor to self, Joseph P. Nelson, and Alonzo C. Carroll, Sutton, N. Hampshire.

Claim.—"I claim my improved clothes dryer, constructed so as to enable the series of arms not only to rotate on the post, but to be elevated and depressed, and so as to remove the clothes out of the way of a person, and to carry them into higher atmospheric currents."

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102. For an *Improvement in Hay and Cotton Presses;* Alders Adams, Jerseyville, Ill.

Claim.—"I claim the combination of the rails, mounted on india rubber, or its equivalent, with the block, so that during the descent of the follower the rails will also rise and lift the frame and pressing box up from the block, ready to be wheeled away."

103. For an *Improved Arrangement of Devices for Applying Power to Fire Engines;* G. Backstein, Philadelphia, Pennsylvania.

Claim.—"I claim the peculiar arrangement of the pulling levers, chains, cross-heads, piston, and cylinder, when used as herein described, and applied to the working of a fire engine."

104. For an *Improvement in the Towel or Clothes Horse;* John Cram, Boston, Mass.

Claim.—"I claim the combination of hanging frames with their jointed connecting bars, and one or more tension racks, or tension racks and the upright frame, all jointed together and made to fold up or to unfold."

105. For an *Improvement in Clover Hullers;* A. B. Crawford, Wooster, Ohio.

Claim.—"I claim the feeding apparatus; that is to say, a rubber formed of segments laid on heads and banded, with deep spiral flutes for taking in the seed, the flutes being filled with teeth similar to saw teeth."

106. For an *Improvement in Seats for Public Buildings;* A. Eliaers, Boston, Mass.

Claim.—"I claim actuating the back by the dropping of the tilting seat, so as to bring it into an upright position, by means of the curved arms attached to or forming a part of the frame work of the back, and acted upon by the rear edge of the seat, or a shoulder in the same."

107. For an *Improvement in Feathering Paddle Wheels;* F. Felter, Amboy, N. J.

Claim.—"I claim the combination of the cranked shafts with the vibrating rods and cam-shaped tracks in the wheel house, whereby said partial rotation is attained in a simple manner."

108. For an *Improvement in Converting Reciprocating into Rotary Motion;* C. B. Gallagher, San Francisco, California.

Claim.—"I claim the mode of applying steam power, caloric, or any other motive power that may use the straight cylinder, to machinery, in place of the crank, varying the same to suit different kinds of engines."

109. For a *Rotary Cooking Stove;* Elias A. Hibbard, Winchester, Virginia.

Claim.—"I claim the combining or arranging the reverse manner of draft, the elevating and receding grate, the return flue, the diving and ascending flue, the angular plates for burning coal, and the rotary top."

110. For an *Improvement in Knitting Machines;* J. Hollen, White Township, Pa.

Claim.—"I claim the combination of the series of projecting teeth with the series of needles, arranged and operating for the purpose of regulating the stitches, and making them even. I claim the depresser, so constructed with its inclined sides as to secure the entrance of the barb into the groove of the needle, in case the needle should vibrate or be bent. I claim the separator, arranged and operating as described, for holding the

thread back out of the way of the stitch. I claim the tramper. I claim the thread depresser, in combination with the thrust of the needle. I claim the vibrating feeder."

111. For an *Improvement in Moulds for Pressing Bonnet Fronts;* Whitten E. Kidd, City of New York.

Claim.—"I claim the method of constructing the die with the curved opening in its side, for the purpose of enabling the workman to guide and steady the material of which the front is composed, whatever the sized front may be."

112. For an *Improvement in Steam Boilers;* Daniel B. Martin, Washington, N. J.

Claim.—"I claim the arrangement of the series of tubes placed vertically, or nearly so, between an upper and a lower and connecting vertical water spaces, when said lower water space is made directly over the fire chamber, and the draft is returned over said lower space and among the vertical tubes."

113. For an *Improvement in Tanks and Cisterns for Supplying Locomotives;* A. W. McDonald, New Creek Depot, Virginia.

Claim.—"I claim, 1st, A water tank, (from which to supply locomotive steam engine boilers with water,) so constructed that it may become, at the will of the engineer in charge of it, an exhausted receiver, as the water is pumped out of it by the engine, and when so exhausted, may be replenished through the pipes, hose, &c., with which I provide it, either when at high speed upon its way, or when brought to a halt. 2d, An improvement upon the tank or tanks, in common use, (for the supply of locomotive steam engine boilers with water,) by providing them with what I have called a tank pipe, trough pipe, guide wheel, and controlling cord, or other equivalent mechanical agents or aids, by which such tanks may be replenished whilst moving at high speed from my cistern. 3d, A new and improved road-side cistern, constructed so that any tank of the construction now commonly used, with my improvement attached, as well as my own tank, may be replenished whilst passing said cistern at high speed, and my own tank, if in an exhausted state, may be replenished, either when under way at any speed, or brought to a halt by the side of said cistern. 4th, My own tank, in connexion or combination with my cistern; and, 5th, My improved tank, or the tank or tanks in common use, improved as above explained and claimed, in combination or connexion with each other."

114. For an *Improvement in Stoves;* J. L. Mott, Mott Haven, New York.

Claim.—"I claim the extended rim or clothes protector, located and combined with the larger diameter of the fire chamber, that it may serve as a protector to prevent burning clothes when carelessly passing."

115. For an *Improvement in making Metal Rods and Tubes;* James Newman, Birmingham, England.

Claim.—"I claim the production of metallic rods, rails, and bars, having the appearance of solid metal, with a core or centre of sand, sandy, earthy, ashy, or other arenaceous material, and of metal tubes, by afterwards burning or drilling out the core or centre."

116. For an *Improvement in Breech Loading Fire Arms;* A. D. Perry, Newark, N. J.

Claim.—"I claim the employment of the revolving segmental breech, having its centre of motion below, and in the line of the face of the breech of the barrel, and a central plug to fit the bore of the barrel, so that when the breech piece and breech of the barrel are brought together they shall fit. Also, in combination with said breech piece, the levers. And, also, in combination with said arrangement or system of levers, the recess in the stock of the arm."

117. For an *Improved Machine for Boring the Chambers in the Cylinders of Fire Arms;* E. K. Root, Hartford, Connecticut.

Claim.—"I claim forming the chuck with a circular eccentric plate, having a recess to receive the block of metal to be drilled or reamed, or either, combined with the body of the chuck, and with a bolt, or its equivalent, so that by turning the said eccentric plate on the body of the chuck, the several holes to be drilled, bored, and reamed, or either, can be brought successively and held in line with the axis of rotation of the mandrel. Also, in combination with the said eccentric plate of the chuck, the radial sliding

gripes operated by the conical surface of the screw ring, for holding and liberating the block of metal, by simply turning the said ring, by means of which the block can at all times be held in the centre of the eccentric plate. Also, the eccentric chuck, in combination with the series of sliding tool carriers, arranged in a circle, so that by turning the series, the several tools can be brought successively in a line with the axis of the mandrel."

118. For an *Improved Piano Forte Action;* Daniel H. Shirley, Boston, Mass.

Claim.—"I claim giving the blow to the hammer, and keeping it always in readiness for a blow, by means of the vertical arm and diagonal arm actuated by the butt. Also, so arranging the back catch as to actuate it by the return of the block on the end of the diagonal arm after each blow."

119. For an *Improvement in Moulds for Pressing Bonnet Frames;* Nathaniel Spence, City of New York.

Claim.—"I claim the arrangement of the metallic die and counter die, with their respective heaters, whereby the dies can be removed without disturbing the heaters, or the heaters removed or changed without opening the dies."

120. For an *Improvement in Looms for Weaving Bags;* Wm. Talbot, Sanford, Me.

Claim.—"I claim, in combination with the jacquard apparatus, or series of lifters, their lifting mechanism and the rotary regulator, pin wheel, or cylinder, or its equivalent, the secondary regulator pin wheel or cylinder, or its equivalent, and a mechanism for imparting to the secondary pin wheel or regulator, its proper motions and intervals of rest, whereby, by the combined action of both regulators, the weaving of the bag and the bottoming of it is carried on, my machinery being adapted to the weaving of plain twilled, or fancy work, as occasion may require."

121. For an *Improved Mitre Box;* William Tinsley, Glens Falls, New York.

Claim.—"I claim the hollow grooved central cylinder, adapted to carry saw guides, said cylinder turning upon a pivot in a hanging adjustable fulcrum, combined with the lumber box, whose back and bed can be adjusted to different angles."

122. For an *Inclined Sliding Valve;* Edward H. Tracy, City of New York.

Claim.—"I claim the shoe attached to or constituting an enlargement of the side of the valve adapted to sliding on the inside of the case, and admitting of a horizontal or inclined position, and action of the stop cock."

123. For an *Improved Rotary Lathe;* George Tugnot, City of New York.

Claim.—"I claim arranging one or more slide rests, to which the cutting tools are attached, within a rotating cylinder."

124. For a *Planing Machine;* Daniel Van Fleet, Sandusky City, Ohio.

Claim.—"We claim, 1st, The employment of the ogee form in the throat of the plane, so as to make a part of that throat, and not otherwise, of such a size that the swelled part of it shall so meet the shaving as to prevent its curling, and pass it outwardly to the depressed part of the form, which discharges it freely without clogging. 2d, The radial arms, in their combination in pairs with the frames carrying the feed rollers and the planing knives."

125. For an *Improvement in Metal Drills;* Wm. Wakely, Homer, New York.

Claim.—"I claim providing the crank with a sliding handle, and arranging the pinion on the same, so that it may be thrown into gear with one or both of the wheels, as occasion may require. Also, the arrangement and combination of the pinion, spur wheels, and drill stock, when provided with a screw. I likewise claim, for the purpose of facilitating the change in the feed of this particular drill, of the wheel in sections, and the substitution of a section having a greater number of teeth, for one having a lesser number."

126. For an *Improvement in Sewing Machines;* T. E. Weed, Williamsburg, N. Y.

Claim.—"I claim the vibrating spring fly, whether adjustable or not, for taking up the slack of the thread during the descent of the needle, and releasing the thread as the needle enters the cloth."

127. For an *Improvement in Washing Machines;* Wm. Wheeler, Acton, Mass.

Claim.—"I claim the method of giving motion to the dasher of a washing machine, by means of the eccentric operating against the elastic plates."

128. For an *Improvement in Windlasses;* Henry Richards and Charles F. Windsor, Boston, Massachusetts.

Claim.—"We claim the screw detached from the windlass and encircling it, by which the cable is caused to fleet itself by the turning of the windlass in heaving in."

129. For an *Improvement in Binding Guides for Sewing Machines;* O. G. Boynton, Haverhill, Assignor to Nehemiah Hunt, Boston, Mass.

Claim.—"I claim so combining with or fixing it on the presser, that it (the said guide,) may be lifted with and by the presser, and rise and fall with it, so as to accommodate the guide to the varying thickness of the material while the sewing of the binding on such material is being effected, and also to support such guide so that it may offer no such obstruction to turning of the cloth on the base plate as it would present were it supported directly on the base plate."

130. For an *Improvement in Sewing Machines;* Thomas J. W. Robertson, Assignor to self and E. A. Beach, City of New York.

Claim.—"I claim, 1st, Making the interlocked stitch by causing the needle to pass its thread over a stationary thread case, in which the other thread is contained. 2d, The combination of the thread case with the thread case holder, by means of a spring, or its equivalent, that is to say, when so arranged as that while the spring holds the thread case securely in place, the thread case holder and spring shall permit the needle thread to be drawn around the thread case to form the stitch. 3d, The combination of the sliding frame, needle bar, and movable case. 4th, The combination of the feeding bar, having a plate and feed roller, with the sliding frame."

131. For an *Improvement in Making Rope and Cordage;* Arad Woodworth, 3d, Boston, Massachusetts, and George Chamberlin, Olean, New York.

Claim.—"We claim, 1st, The arrangement of the bevel gears, or their equivalents, with their guiding holes for conducting each thread, arranged outside of the centre of the said gears, as set forth, whereby a draft is created upon each thread separately, and the threads in the several spool frames are prevented from being twisted or formed into strands, until they are brought together and drawn out of the last spool frame. 2d, We claim giving the strands, after they are formed, a revolution at the same time and in the same direction that the laying up machinery revolves, for the purpose of preventing the twist first given from being partially lost or broken out, by the process of laying them up, by which each strand retains the same amount of twist that was imparted to it by the twisting machinery, thus forming an even and hard twisted rope."

Additional Improvement.

1. For an *Improvement in the Construction of Reed Musical Instruments;* F. A. Gleason, Rome, N. Y.; dated Nov. 14, 1854; additional to patent dated June 20, 1854.

Claim.—"I claim the application of hammers to reeds, operated as described, or by any similar method producing the same result."

Re-Issues for November, 1854.

1. For an *Improvement in Winnowing Machines;* Samuel Canby, Ellicott's Mills, Maryland; dated Nov. 14th, 1854; originally dated Dec. 28, 1852.

Claim.—"I claim the automatic graduation of the fan blast, by means of a piston in a passage communicating with the fan case, balanced by weight, to support the atmospheric pressure due to the rarefaction produced by a given velocity of the fan, but movable when said velocity varies, and by connexion with valves regulating air passages so operating them as to diminish the capacity of said passages when the velocity of the fan is too great, and produce the contrary effect if the blast be weakened by a diminished velocity of the fan."

2. For *Improved Rake to Harvesting Machines;* Sylvanus Miller, Urbana, Ohio; dated Nov. 21st, 1854; originally dated July 15th, 1851.

Claim.—"I claim the guide, arranged in connexion with the tilting roller, for the guidance of the rake in a path similar to that which it would receive from the human hand, by which it removes, periodically, the grain or grass from the bed, and frees itself by the retraction of the teeth endwise. Also, the application of a thin light roof to the rakes for harvesters, for the purpose of effecting the separation of the gravel from the falling grain."

DESIGNS FOR NOVEMBER, 1854.

1. For a *Bar Room Stove;* Jacob Beesley, Assignor to W. P. Cresson & Co., Philadelphia, Penna.; dated Nov. 7th, 1854; ante-dated May 7th, 1854.

Claim.—"I claim the design for bar room stove, as set forth."

2. For *Egg Stoves;* David Stuart, Assignor to W. P. Cresson & Co., Philadelphia, Pennsylvania; dated Nov. 7th, 1854; ante-dated May 7th, 1854.

Claim.—"I claim the design for egg stove."

3. For *Wire Fences;* Matthias Lachenmaier, Philadelphia, Pa.; dated Nov. 21, 1854.

Claim.—"I claim the combination and arrangement of the horizontal twists above and below the rosettes, forming, together with the wire and rails, an ornamental design for a wire fence, characterized by a horizontal row of rosettes combined with the wires, so as to be intermediate or between every two horizontal parallel rows of the horizontal twists."

4. For *Stoves;* Horace W. Robbins, Baltimore, Maryland; dated Nov. 28th, 1854.

Claim.—"I claim the configuration of the radials, in combination with the polished formations, together with the drops and the staminated cornice."

DECEMBER 7.

1. For an *Improvement in Seats for Public Buildings;* A. H. Allen, Boston, Mass.

Claim.—"I claim the seat, constructed, hung, and adjusted, so as to assume and retain the vertical position when not in use, whether by means of the weight or spring, or sliding back, connected and supported by means of the shafts, or by pins or other analogous devices, for the connexion and support of the seat."

2. For an *Improved Oven for Baking;* G. S. Blodgett and P. T. Sweet, Burlington, Vt.

Claim.—"We claim the use of galvanized iron in the construction of ovens, for the purpose of cooking and baking meats and other articles, with this form and kind of furnace."

3. For an *Improvement in Steam Boiler Alarm;* Patrick Clark, Rahway, N. Jersey.

Claim.—"I claim, 1st, The arrangement of the wheel, turning on the screw of the tube, with its rods and caps, or any equivalent device, when actuated by the spring, or its equivalent, in relation to the valve stem and the tube, by means of which the arrangement adjusts itself to the varying length of the tube, as it contracts in cooling after having given an alarm, or after having been used as an ordinary gauge cock. 2d, The arrangement of the bell and disk on the valve stem of the valve of the whistle, when and only when such arrangement is used in combination with the arrangement of the first claim."

4. For an *Improved Arrangement for Reefing Topsails;* H. J. Crandall, Boston, Mass.

Claim.—"I claim the arrangement of the rod with the leaders on the underside of the yard, and the manner of reeving the reef lines and pennants attached to the close reef through the leaders connected with the other reefs, and the connecting the reef points with leaders for the reef lines on the after-side of the sail, and the peculiar arrangement together of the aforementioned parts."

5. For an *Improvement in Steering Apparatus;* Joseph D. Crowell, Boston, Mass.

Claim.—"I claim the manner in which I have combined or arranged the operative parts of the said steering apparatus, the rudder head, and the tiller, the bearings of the steering wheel being supported directly on the upper end of the rudder, and that of the tiller, while the curved rack is elevated above the deck, and to or about to the level with the top of the rudder head and tiller, such not only enabling a single pinion and rack to be used in connexion with the steering wheel shaft, sustained as specified, but rendering the whole apparatus simple and efficient in operation, and very cheap in point of construction, and little liable to get out of repair."

6. For a *Rotary Pump;* Joshua Gray, Boston, Massachusetts.

Claim.—"I claim the combination of the two flat cones and the flexible diaphragm or partition applied together, and in a case provided with ingress and egress pipes or orifices, such cones being arranged in contact, and with their axes at an angle to each other, and the whole being made to operate together."

7. For an *Improvement in Railroad Car Seats;* John T. Hammit, Philadelphia, Pa.

Claim.—"I claim, 1st, Placing the legs or wheels, or wheels in the legs, in such a position in relation to the pivot on which the seat revolves that as the seat is turned, they, the legs or wheels, shall not run into or across any sockets except those in which it is intended they shall stop. 2d, Placing the pivot near the front edge of the seat, so that it may be made longer and turned without coming in contact with the side of the car, thereby permitting the seats to be made longer and arranged to turn in a car of a given width, without reducing the width of the avenue or space between the ends of the seats."

8. For an *Improvement in Railroad Switches;* Samuel P. Kittle, Buffalo, N. York.

Claim.—"I claim the moving of the switch by the passing train, through the intervention of a slotted cam, which will move and then hold or lock the switch to either rail against the lateral pressure, without the use of any other device than the slot, pin, and pivot."

9. For an *Improvement in Machinery for Separating the Fibre from the Woody Portions of Tropical Plants;* John Lilley, Birkenhead, England; patented in England, July 21st, 1853.

Claim.—"I claim the combination of the yielding knives or scrapers with the rollers, when said knives or scrapers are hung on a toggle joint and operated by cams, and thrown out of or into action with said cams by weighted levers, first to receive the material, and then to divest it of the refuse matter."

10. For an *Improved Machine for Rounding the Backs of Books;* Leonard F. Markham, Cambridgeport, Massachusetts.

Claim.—"I claim, 1st, The combination of a presser bar hung upon proper journals, with a yielding table upon which the book is placed, the back of the book being shaped by the action of the said presser bar and table. Also, a presser bar hung upon sliding journals, and actuated by the friction rollers and curved guides, so as to give a forward motion to the said presser bar, and thereby adapt the machine to rounding the backs of thick books."

11. For an *Improvement in Paper Making Machines;* Obadiah Marland, Boston, Mass.; patented in England, September 28th, 1854.

Claim.—"I claim vibrating the revolving cylinder mould, and the parts immediately connected therewith."

12. For an *Improvement in Paper Making Machines;* Obadiah Marland, Boston, Mass.; patented in England, September 28th, 1854.

Claim.—"I claim producing within the vat of a cylinder paper making machine, currents and counter currents of the pulp, parallel or nearly so to the axis of the cylinder, by the use of spiral conveyors operating within the partitioned shell, or by means of their mechanical equivalents."

13. For an *Improvement in Wash Stands;* W. H. Miller, Brandenburg, Kentucky.

Claim.—"I claim a wash stand made in sections, and having its parts constructed so

as to form a clear water reservoir, a waste water reservoir to receive the waste water from the basin, rim basin, and table top."

11. For an *Improved Mill for Shelling and Grinding Corn;* Henry R. Miller, Louisville, Kentucky.

Claim.—"I claim the construction and arrangement of the circumscribed or inclosed concave, having their draft shoulders of equal depth, or thereabouts, and made with an abrupt stop on their outer corner, by the junction of the outer boundary line of the concave with the shoulder, when combined and operating together with the adjusting bosom in the other stone, and extending to cover or act over the whole surface of the concave, whereby the ears of corn fed into between the stones promiscuously, and several at a time, are prevented from passing out of the concave otherwise than over the draft shoulder, and are gradually turned, borne, or otherwise pressed by the bosom against the draft shoulder to an equal extent of contact therewith throughout their length, for the better adjustment of the several ears into a proper crosswise position for 'shelling' and travel between the inner furrowed surfaces of the stone."

13. For an *Improved Machine for Crushing Ores;* Wm. H. Plumb, City of N. Y.

Claim.—"I claim the rollers upon the radial arms of the shaft, connected with the movable arms, or their equivalent, and revolving in a basin whose inner surface is eccentric to the roller's shaft."

16. For an *Improvement in Steam Boilers;* John A. Roebling, Trenton, N. Jersey.

Claim.—"I claim the arrangement of the extended grate surface, elaborating or central combination chamber, the tube sheets, and the tubular water surface between the said sheets."

17. For an *Improvement in Railroad Car Brakes;* Michael Shimer, Uniontown, Pa.

Claim.—"I claim the inclined curved bar and elliptical spring, in combination with the elastic chain and the slotted bar, for the purpose of preventing a concussion when the car wheel strikes the curved bar and spring, and also for the purpose of preventing the shoe from being broken."

18. For an *Improvement in Dry Docks;* James E. Simpson, East Boston, Mass.

Claim.—"I claim the method of constructing dry docks, by making use of the natural stratum of clay for the floor of the dock, and continuing the same up through the walls by means of puddling, the front of the dock being furnished with gates for the admission of the vessel."

19. For an *Improvement in Casting Metal Window Sashes;* T. J. Sloan, City of N. Y.

Claim.—"I claim moulding and casting metallic window sashes with auxiliary bars, substantially as herein specified, to keep the rails straight during the contraction of the metal in cooling, and then to be cut or broken out."

20. For an *Improvement in Running Gear for Railroad Cars;* David G. Smith, Carbondale, Pennsylvania.

Claim.—"I claim a six-wheeled truck, having on that end of it next the end of the car, a pair of wheels with semi-conical treads and no flanches, and united to the truck frame, which is also supported on two other pairs of wheels of the ordinary construction, by the supporting plate, king bolts, and connecting rods, so that said pair of wheels may have a lateral motion on the rails, independent of the other pairs, and yet support their due proportion of the weight of the car."

21. For an *Improvement in the Manufacture of Brushes;* M. Stewart, Philada., Pa.

Claim.—"I claim the use, in combination with conical or enlarged tubes, of a wire for binding the knot of bristles before their insertion, the said wire being supported or held by coming in contact with the sides of the tubes, or suitable projections thereon."

22. For a *Method of Extinguishing Fire in Inaccessible Places;* Amasa Stone, Philadelphia, Pennsylvania.

Claim.—"I claim, 1st, The arrangement of the rotating or oscillating reservoir furnished with the jets connected with exterior water pipes, and operating so as to diffuse jets or streams of water. 2d, The peculiar combination of reacting arms, valve, and

reservoir, by which, in one modification of my apparatus, the desired rotation or oscillation is effected."

23. For a *Mode of Regulating the Furnaces of Hot Water Apparatus;* T. T. Tasker, Philadelphia, Pennsylvania.

Claim.—"I claim the arrangement of the two sets of floats operating the valve and damper, and the open vessel, in combination with a circulating hot water apparatus."

24. For an *Improvement in Covering Cotton Thread with Wool;* James Taylor, Newark, New Jersey.

Claim.—"I claim the employment of the rubbing rollers, in combination with the arrangement of mechanism, for uniting the bands of wool around the cotton thread."

25. For an *Improvement in Lanterns;* Wm. D. Titus, Brooklyn, New York.

Claim.—"I claim the combination with the lantern case of the slotted cover, which is so arranged as to fall by its own gravity, and fit upon the match holder during the operation of lighting the lamp."

26. For a *Hydraulic Ram;* Ellis Webb, Parkersville, Pennsylvania.

Claim.—"I claim, 1st, The valve, composed of a hollow cylinder having its upper end open, and its lower end closed, and extending up above the water and packing line, so that in rising it will rise against the air instead of the column of water within the air chamber. Also, the method herein described, of introducing the oleagenous packing, or its equivalent, on top of the water in the chamber, for the purpose of preventing the water from taking up and carrying out with it the air which should be contained therein. Also, in combination with the rising main or discharge pipe, the check valve for preventing any re-action in said pipe from extending back into and endangering any of the operating parts of the machine."

27. For an *Improvement in Churns;* Elbridge Webber, Gardiner, Maine.

Claim.—"I claim the combination of the flanched inverted conical dasher with the inverted conical cream chamber."

28. For an *Improvement in Grain and Grass Harvesters;* Cyrenus Wheeler, Jr., Poplar Ridge, New York.

Claim.—"I claim the hanging the cutter bar, provided for the purpose with a socket, to one extremity of the arched bar by means of joints and segments, said arched bar being in its turn pivoted to the main frame, all for the purpose of giving the cutter bar, by means of levers, a motion independent of the frame, and both rotating longitudinally parallel to the ground, and oscillating radially from the joints, in order to adapt the same to the inequalities of the ground, or to stop its action at pleasure."

29. For an *Improvement in Dry Gas Metres;* Franklin Darracott, Assignor to George Darracott, Boston, Massachusetts.

Claim.—"I claim the use of measuring chambers arranged in pairs, as described, and similarly inclosed by means of the flexible leather secured to the stationary and movable diaphragm, the latter between the chambers, and forming one side of each of them, and connected to the parts which they are to actuate, by means of attachments to their peripheries. 2d, In combination with the measuring chamber of a dry gas metre, the within described rotating valve, with its inlet and outlet passages, constructed and operating as set forth. 3d, Opening a communication between the space which surrounds the measuring chambers and the inlet pipe, when the registering takes place only from the gas within the chambers, whereby an equal and uniform pressure exists at all times upon both sides of the leather which unites the diaphragm, and all loss of gas by transmission through its pores is avoided."

30. For an *Improvement in Knitting Machines;* John Pepper, Jr., Portsmouth, N. H., Assignor to the Franklin Mills.

Claim.—"I claim combining an annular series of hooked needles and a series of radial and sliding hooked needles, so as to operate together, and with a rotary toothed wheel or sinker, and two rotary presser wheels, and produce ribbed work. Also, the improvement of making a part of the cam or lip of the cam plate adjustable, for the purpose of removing a needle of the second series from the seat, when necessary or desirable. And, also, the arrangement of the second series of needles, with respect

to the other or first series, that is to say, the so arranging them that their plane shall cut that of the upper ends of the needles of the first set, and dips below and rises above the same, as stated, such an arrangement causing the stitches of the first set of needles to be elevated and cast off or over the loops or yarn of the second set, by the lifting power or action of the series during the rotary movement."

31. For an *Improved Lubricating Apparatus;* J. Regester, Assignor to E. Clampitt and J. Regester, Baltimore, Maryland.

Claim.—"I claim the combination of the reservoir for containing the oil or lubricating fluid with the central conical stem or spindle, by means of two sockets or bearings, one of which is at the upper and the other at the lower or bottom part of the reservoir, in which sockets there are pssages corresponding with other passages or vents in the bearings of the central stem, which top and bottom passages are alternately opened and shut by the moving of the reservoir around the central stem."

32. For an *Improved Quartz Crusher;* J. W. Cochran, City of New York, dated Nov. 28th, 1854; patented in England, Nov. 21, 1853.

Claim.—"I claim, 1st, The movable dies or bushings, either with or without the india rubber, or other elastic interlining or cushion, in combination with the revolving disk or plate, and balls or shells. 2d, The manner of arranging and stretching the wire gauze or screen in pannels, and securing them to the standards so as to give a uniform surface to the inner surface of the screen. 3d, The connecting shaft for coupling the driving shaft with the revolving plate or disk, admitting the revolving plate or disk to vibrate laterally or vertically without affecting the driving shaft or its bearings."

DECEMBER 12.

33. For an *Improvement in Polygraphs;* Nathan Ames, Saugus, Massachusetts.

Claim.—"I claim the horizontal parallel wires, and the connecting wires, so that by means of themselves the pen holder may be supported and guided with as little complexity, weight, friction, and liability of getting out of repair as possible, the simple weight of the wires and pen holder always preventing the joints from wearing loose, and the elasticity of the wires always supporting the wires at a small but equal distance from the surface of the paper whenever they are not pressed down by the operator in writing, copying, or drawing,"

34. For an *Improved Polygraph;* Nathan Ames, Saugus, Massachusetts.

Claim.—"I claim, 1st, Arranging two or more tables, one above the other, for the purpose of writing simultaneously on two or more sheets of paper. 2d, Arranging two or more pens, one above the other, in the end of a forked pen holder, consisting of as many prongs as there are tables, all the pens being moved and guided simultaneously in the same, and in any direction. 3d, Arranging one ink stand above another, as described, in order that all the pens in the different prongs may be supplied with ink at the same time. Lastly, the method of confining the sheets of paper, or the leaf of a book, to the under table or tables."

35. For an *Improvement in Operating Looms by Electricity;* Gaetan Bonelli, Turin, Sardinia; patented in France, August 15th, 1853.

Claim.—"I claim, 1st, The application of electricity, or of electro-magnets, to power looms, in order to raise and keep in an elevated state the hooks and heddles, in the required order to form the design or pattern of fashioned stuffs, such as shawls, carpets, ribbons, &c. 2d, The various means of making such designs on metallic surfaces, by means of an insulating material, and the use for this purpose of varnish of weavings of paper painted or colored with metallic substances, of paper cut out or pinked or pierced, &c."

36. For an *Improvement in Hanging Carriage Bodies;* B. F. Brown, Dorchester, Mass.

Claim.—"I claim the combination of the spring and perches for sustaining the weight of the carriage body, and for relieving the said carriage body from sudden jolts, the combined action springs and perches being such as to give an easy and elastic motion to the carriage body. I claim the combination of the springs, perches, and thorough braces, the said thorough braces operating to give an easy motion to the carriage body, and preventing the swaying of the said carriage body from twisting or bending the spring."

37. For an *Improvement in Oscillating Steam Engines;* Mathew Cridge and Samuel Wadsworth, Pittsburgh, Pennsylvania.

Claim.—"We claim the arrangement of adjusting the side pipe of an oscillating engine by means of set screws, to act directly on the places where the steam reacts on, viz: opposite the steam and escape openings in the surfaces of the side pipe, and of resisting at the same time the reacting power of the steam against the side of the cylinder by means of a counter set screw, or by any other means being for the same purpose. The set screw and counter set screw forming a complete system of regulation, for the purpose of keeping the surfaces between cylinder and side pipe steam tight, and adjusting the position of the cylinders."

38. For an *Improvement in Machines for Bending Metals;* William W. Cumberland, Newark, New Jersey.

Claim.—"I claim, 1st, The arrangement and connexion, in any manner, of the parts termed respectively, the bed, the down-hold, and the die-piece, and employed, the two former for holding the slat or piece of metal to be operated upon, and the latter for holding the die or dies, whereby the resistance of the slat or piece operated upon, to the bending or forming operation, causes it to transmit the power necessary to produce the pressure for holding it. 2d, Furnishing the down-hold or movable holding part with a catch, which is so formed and arranged that it may be brought to a suitable position on the die-piece, or on an arm attached thereto, when the die-piece has moved back to a certain distance after the die has done its work, and thereby attach the down-hold to the die-piece, so that the former is raised by the movement of the latter, and thus caused to liberate the slat, or other articles which it has held in place. 3d, Controlling the operation of the catch so that it shall only catch the die-piece during every second return movement, or after it has made as many movements as may be necessary to produce the required form on the slat or other article, by means of the lifter wheel, ratchet, and click piece. 4th, Constructing the back part of the face of the down-hold with a series of projections and recesses, and the front of the die-piece above the die, with similar projections and recesses, fitting to the projecting recesses on the down-hold, for the purpose of affording support to the upper side of the slat or piece on the side opposite the bend, during the bending operation, and allowing the die to work up as close as is necessary to the edge of the bed and down-hold. 5th, The employment of two or more dies of different depth, or of different form, arranged in or upon a roll, which has such movements on its axis as to bring the said dies successively into operation upon the slat, or other article, whereby a form requiring two or more distinct operations of the die to produce it, is produced on the slat or article without releasing it. 6th, Attaching the back-hold plate, which regulates the position of the slats on the bed, to the bed by springs of any suitable description, for the purpose of allowing it to yield to the movement which the slat is caused to receive upon the bed by the tightening of the down-hold, and for allowing the movement which is given, for the purpose of throwing out the slat. 7th, Furnishing the back-hold plate with a flap piece, hinged to it so as to be thrown down on the bed at pleasure, for the purpose of regulating the position of the slat when the second scroll is to be formed, and compensating for the reduced width of the slat caused by the bending of the first scroll. 8th, Giving to the back-hold plates the necessary movement to expel the slat or piece after the scroll or other form is produced on either edge thereof, and suddenly leaving it free to be returned by the action of the springs to the proper position to adjust a new slat or piece upon the bed, by connecting it with a lever which is furnished with a springing piece which is operated upon by pieces attached to the down-hold, every time the latter moves to liberate a slat or piece. 9th, The arrangement of dies relatively to the arc described by the axis of the die roll, whereby the resistance of the metal to the bending or forming operations of the two dies is made to act in such a direction as to cause the die to have a tendency to turn on its axis in the proper direction to bring the projecting piece into contact with the stop, as may be required. 10th, The method of turning the die roll back and forth to change the positions of the dies, by means of catches, which are attached to the bed, and stand in such positions that when the die-piece swings back, they catch on studs attached to the die roll at a distance from its axis. 11th, Attaching the studs to a pair of levers which are attached to the die roll, and are so formed, and arranged and controlled by a spring, that when the studs are caught by catches which turn the die roll on its axis, the levers are caused to act upon a double pawl, which is so arranged as to fall behind either of two projecting pieces on

the die roll, for the purpose of holding it against one of two fixed stops, and to move the said pawl so as to release one of the projecting pieces, and fall behind the other, and thus release the die roll from the position in which one die is operative, and secure it after it has been moved to the position in which the other die is operative. 12th, The arrangement of the preparatory dies relatively to the bed, the down-hold, and the die-piece which carries the bending dies, whereby the attendant is enabled to conduct the operations of the preparatory dies upon one slat, and the bending dies upon another slat at the same time."

39. For an *Improvement in Machines for Crushing and Grinding Minerals and other Substances;* T. O. Cutler, City of New York.

Claim.—"I claim combining with the rotating pan or shell, having a rim against which the substance to be crushed or ground is distributed and held by centrifugal force, one or more wheels with rounded or beveled treads, and turning on axes radiating or nearly so from the axis of the fan or shell, and whose planes of motion are tangent to a circle of less diameter than the rim of the pan."

40. For an *Improvement in Throstles for Spinning Cotton;* Charles Danforth, Paterson, New Jersey.

Claim.—"I claim the connecting together the spindle rails from side to side of the frame, in two or more sections, connecting the guards and guide wire boards with the spindle rails, so that they will traverse with them, and constructing and arranging the transverse movements so that the different sections will counterbalance each other."

41. For an *Improved Method of Destroying Vermin;* G. W. French and Wm. Wagstaff, Cambridge, Massachusetts.

Claim.—"We claim the use of a current of steam issuing from a boiler under high pressure, in such manner as to mix with a current of heated air, and to drive the mixture forcibly forward in a somewhat confined state until it comes in contact with furniture, fabrics, &c., in order rapidly to heat the surfaces and crevices, for the purpose of destroying vermin, without injury to either cabinet ware, woolen, or other fabrics."

42. For an *Improvement in Hoes;* Moses Gates, Gallipolis, Ohio.

Claim.—"I claim the construction of the tube or socket with a shoulder on the end to be attached to the blade or plate, the attachment of the same to the plate by drawing it through the plate and hammering down the end of the tube so as to form a burr or rivet head on the outside of the plate, and the more firm attachment of the tube or socket to the plate by soldering or brazing."

43. For an *Improvement in Coffins;* John Good, Philadelphia, Pennsylvania.

Claim.—"I claim the collar and the reservoirs, in connexion with the pipes and the various parts, being arranged as set forth."

44. For *Improvements in Harrows;* E. L. Hager, Frankfort, New York.

Claim.—"I claim the manner of securing the harrow teeth to the frame, in combination with the means employed for making said teeth capable of being adjusted from a vertical to an oblique position, and of being set to any depth desired."

45. For *Angler's Combined Float and Sinker;* J. W. Hoard, Providence, R. Island.

Claim.—"I claim making the sinker hollow, and providing one end thereof with an aperture through which the interior may be loaded and unloaded."

46. For an *Improvement for Securing Carpets to Floors;* E. Jackson, Portland, Conn.

Claim.—"I claim the hook, hooks, or claws on the loop, by which said apparatus may be attached to when fastening carpets to floors, or detached from when taking them up, at pleasure."

47. For an *Improvement in Hub Bands for Carriages;* J. Jenkins and J. R. Cooke, Winsted, Connecticut.

Claim.—"We claim the combination of the serrated projections with the inclined planes, and one or two spring clicks or dogs."

48. For an *Improvement in Flyers;* Edward C. Johnson, Lowell, Massachusetts.

Claim.—"I claim the arrangement and combination of the pin (fastened in the end of the arm of the flyer by a set screw,) in connexion with the spiral spring, in such a

manner as to render the presser easily adjustable, and so that both the spring and pin shall be contained within the barrel of the presser."

49. For an *Improvement in Cut-off Regulators for Steam Engines;* H. A. Luttgens, Paterson, New Jersey.

Claim.—"I claim operating the cut-off eccentric, which is fitted to turn freely on its shaft, by means of friction produced by the eccentric strap, and the friction produced by a brake strap upon a brake pulley, in connexion with the gearing and segment, the spindle connecting pinion and spur wheel revolving freely in a bearing stationary upon and parallel to the crank shaft, the mechanism receiving its impulse from the revolution of the latter, the whole operating to the effect that any friction produced by the brake strap upon the brake pulley greater or lesser than necessary to counterbalance the friction of the eccentric to turn upon the shaft and alter its angular position to the crank, the brake strap being operated upon by a steam engine governor of common construction."

50. For *Feed Motion for Sawing Light Lumber,* John F. Lovecraft, Rochester, N. Y.

Claim.—"I claim the feed motion for saw mills, said motion consisting of two or more small saws, so united together that the teeth of one come opposite the spaces of the other, and so arranged that they can be adjusted so as to be caused to enter the board to a greater or less depth, as desired, or to be entirely out of the way when the table is being used for a different purpose."

51. For an *Improvement in Sewing Machines;* Wm. Lyon, Newark, N. Jersey.

Claim.—"I claim, 1st, The arrangement of the feeding pieces, that is to say, the rod suspended at one end by an universal joint, so that the unattached end may be permitted to play vertically, and also to rock or vibrate as an axis, and having on said unattached end a feeding finger and arm, in combination with the governing studs upon the wheel. 2d, The clamp in combination with the needle bar, and working in connexion with the feeding finger."

52. For an *Improvement in Propulsion of Vessels;* Henry H. Olds, N. Haven, Conn.

Claim.—"I claim, 1st, The combination of the extension guide bars with the frame, propellers, shifting bars, and cross heads. 2d, The combination of the shifting bars, catch, and shifting float, with the frame."

53. For an *Improvement in Dock Holders for Horses;* Eldridge H. Penfield, Middletown, Connecticut.

Claim.—"I claim fitting a pad upon the rump of the horse near the tail, which may be sustained in its proper position by a crupper passing under the tail, and a strap going forward to be attached to a surcingle or a breast girt, according to convenience, to the rear end of which I attach, by a joint, a spring, and hold it in its desired position by a ratchet and ratchet wheel, and attach this spring to the horse's tail by straps passing round both at suitable distances."

54. For an *Improved Gold Collector;* James Perry, City of New York.

Claim.—"I claim collecting the matter containing gold and other precious substances in the beds of rivers, ravines, gulches, &c., carried along by the force of the stream, by placing in the bottom of such stream a box or other vessel, with a perforated plate at top, and an inclined bottom, discharging into a receiving trunk, or equivalent therefor, so that the particles that pass through the holes in being washed over with the debris by the force of the stream, will gradually descend on the inclined bottom and be discharged into the trunk, whilst the lighter substances floating, will escape through the holes in the top plate. Also, making the holes in the top plate of such an apparatus larger towards the rear end, in combination with the compartments formed by the inclined partitions dividing the inside into compartments with inclined bottoms leading to the trunk. Also, in combination with an apparatus, the employment of a top screen composed of bars to protect the perforated plate from the injurious action of large masses passing over it, and to aid in keeping the holes in the said perforated plate from being clogged. Also, the pocket at the lower end of the apparatus, in which are collected the precious substances that pass over the perforations in the top plate, when this is combined with the said perforated plate, and the compartments and trunk below it. And, finally, the vertical trunk, or equivalent receptacles, and with or without an elevation, in combination with the horizontal trunk, and the compartments below the perforated plate, whereby the

substances collected in the apparatus can be withdrawn therefrom without removing the apparatus from its location."

55. For an *Improvement in Cheese Vats;* Henry A. Roe, West Andover, Ohio.

Claim.—"I claim the combination of the boiler and pipes with the chamber, funnel, and vat, connected with the frame."

56. For an *Improved Hygrometric Regulator for Hot Water Apparatus;* J. H. Ross, City of New York.

Claim.—"I claim the regulating of the hygrometric condition of the air in apartments, by opening or closing the valves in the pipes by the balance lever, its action being self-adjusting through the excess or diminution of vapor imparted to the equipoise, irrespective of the material of which said equipoise is constructed."

57. For an *Improvement in Looms;* George Roth, City of New York.

Claim.—"I claim suspending the griff frame and the neck board wholly or in part from opposite arms of levers on a rock shaft, or what is equivalent, on cams on rotary shafts, in such a manner that the weight or tension of those cords of the harness which are caught by the griff frame shall be balanced or nearly so by the weight or tension of those which are missed by the said frame, and rest on the neck board."

58. For a *Rattan Machine;* Sylvanus Sawyer, Fitchburg, Massachusetts.

Claim.—"I claim the combination of a mechanism for dressing the enamelled side of the strand of rattan, and a mechanism for reducing a strand to its proper thickness. Also, the combination of a mechanism for reducing the strand to a proper thickness, and a mechanism for reducing it to its proper width. Also, the combination and arrangement of a mechanism for reducing the enamelled surface or side of the strand, or removing the joints or other protuberances therefrom, a mechanism for reducing a strand to its proper thickness, and a mechanism for reducing it to its proper width, the same being made to act together automatically."

59. For an *Improvement in Sewing Machines;* Geo. W. Stedman, Vienna, N. York.

Claim.—"I claim the tube, receiving thread and acting in combination with the needle, so that each forms a series of loops, each of which loops receives one, and is received by the next one of the other series."

60. For an *Improvement in Seed Planters and Cultivators;* D. W. Shares, Hamden, Conn.

Claim.—"I claim connecting the wings or shoes to each other and to the frame of the machine, in such manner that they are made capable of universal adjustment by hanging them so that they may be turned on extension bars, or rods projecting horizontally from the rear hinge, and uniting them together, or otherwise equivalently hanging and connecting them, so that the wings or shoes may not only be expanded and contracted to vary their width apart, but may also have their depth of entry into the ground, and angular set in direction of their depth varied to suit various widths of the wings apart, and various conditions of the soil or other controlling circumstances. And, further, the arrangement of the beveling or finishing plate operating in rear of the covering portion of the wings, to slightly flatten the tops of the rows, and give a neat and substantial finish to them."

61. For an *Improvement in Machinery for Scraping Metals;* J. Stever, Bristol, Conn.

Claim.—"I claim the arrangement of the driving shaft, the connecting rod, the slotted lever and its fulcrum lever, in connexion with the rod and its rocker shaft, the whole being for giving the scraper the double motion, and regulating the same."

62. For an *Improvement in Processes of Treating the Mother Water of Salines;* Edward Stieren, Tarentown, Pennsylvania.

Claim.—"I claim the process for treating the bitter water of such of the salines of the United States, for the purpose of obtaining epsom salts, (or sulphate of magnesia,) iodine, bromine, and a portion of refined table salt."

63. For a *Boring Machine;* Benjamin F. Taft, South Groton, Massachusetts.

Claim.—"I claim the method of arranging and reversing the longitudinal motion of the boring tool automatically, so as to bore the holes accurately to the required depth, and then withdraw the boring tool. Also, the peculiar construction of the teeth of the

rack and wheel, whereby they can be suddenly, and at any point during the descent of the tool engaged to arrest the boring at the instant required, and also so that in reversing the motion of the crank to turn the screw point of the auger out of the wood, the rack will yield to let the teeth of the pinion slip until the screw point is withdrawn, when, by reversing the motion of the cranks, the auger will be raised out of its hole. Also, the combination of the projection on the carriage with the adjustable arm and the bolts, whereby the rack is released and left free to engage with the wheel, when the boring tool has descended to the required depth. Likewise, the combination of the projection on the carriage with the spring lever and the thumb lever, whereby the carriage is held up when the boring tool is withdrawn from the wood, and the boring suspended, and when it is required to resume the boring, the rack is disengaged from the wheel, and the end of the lever withdrawn from beneath the projection to leave the carriage free to ascend."

64. For an *Improvement in Condensers for Steam Engines;* H. Waterman, Hudson, New York.

Claim.—"I claim the mode of forming and placing the tubes of a condenser, by the employment of collars, either with or without the conical pierced tube sheet, and made at the joints air tight, by means of the india rubber packing, or its equivalent."

65. For an *Improved Hot Air Furnace;* Daniel P. Weeks, Malden, Massachusetts.

Claim.—"I claim the combination and arrangement of the extended flame chamber, (leading out of the fire-pot,) the two sets of lateral horizontal radiator pipes, the connexion pipes, the radiator pipe, and the flue or pipe connected with the fire chamber and pipe."

66. For an *Improvement in Door Locks;* Jacob Weimar, City of New York.

Claim.—"I claim the employment or use of the two sets of slotted circular tumblers, toothed wheels, disk, and pawls, one set being placed upon a shaft attached to the bolts, and the other set placed upon a shaft attached to a sliding plate, so that when the bolt is thrown forward, both sets of tumblers will be thrown in gear with the toothed wheels, and thereby allowing the slats in the tumblers being moved so as to be out of line with the projections, the pawls preventing the wheels being moved until the disk is also turned or moved the proper distance, and thus preventing the lock being picked by tampering with, or trying the tumblers, in order to get a pressure of the bolt thereon."

67. For a *Machine for Dressing Felloes;* Charles W. Wyatt, Newburgh, New York.

Claim.—"I claim, 1st, The method of dressing, which consists in securing the felloe within a horizontally rotating frame, and subjecting the felloe to the action of suitable cutters during said rotation, the axis of the frame and consequently the curve of the felloe being changeable at pleasure. 2d, The combination of the cutters and stocks. 3d, The combination of the spring with the lever and standard."

68. For an *Improvement in Ships' Windlasses;* David L. Winsor, Duxbury, Mass.

Claim.—"I claim forming on the surface of the barrel of a windlass, a series of spiral scores or grooves to fleet the chain. Also, placing friction on the larger and inclined portion of the windlass barrel, for the purpose of aiding in fleeting the chain."

69. For an *Improvement in Seed Planters;* John Andrews, Assignor to himself, N. A. Richardson, and Gardner Symmes, Winchester, Massachusetts.

Claim.—"I claim, 1st, The swinging or seed sower. 2d, The box and sieve, as applied to the scatterer, for the purpose of separating the seeds of weeds from the grain. 3d, The method of raising and lowering the scatterer, by means of the screw, or its equivalent."

70. For an *Improvement in Water Proofing Cloth, &c.;* M. J. Lieberman, subject of the Emperor of Russia, at present residing in the City of New York, Assignor to G. S., S. H., and J. E. Hanford, City of New York.

Claim.—"I claim the process of preparing oiled muslin, or other similar fabrics, by means of oils, sugar of lead, and a stove room or drying oven."

71. For an *Improvement in Casting Spouts of Tea Pots;* Henry Tiebe and William Muhle, Assignors to themselves and H. H. Homan, Cincinnati, Ohio.

Claim.—"We claim confining the congelation of the metal or 'stock' in casting, to

an exact joining edge or margin, by applying a part of the mould at a heat above the fusing of the said stock, whether used for forming the base of the tea pot spouts, or otherwise."

72. For an *Improvement in Trussing Yards to Vessels' Masts;* Joseph Perkins, Assignor to self and H. P. Upton, Salem, Massachusetts.

Claim.—"I claim placing the centre of the fore and aft movements of vesssel's yards nearer to the yards than to the masts, when the so placing of its centre of movements is combined with the extension of the rocker bolt or spindle through the projector or gallows brace, into a fixed bearing upon the mast."

MECHANICS, PHYSICS, AND CHEMISTRY.

*On an Improved Water-Metre.**

The rapid growth of water-works, in this and other civilized countries, extending to towns of second and third rate importance, has rendered the production of an efficient water-metre a matter of considerable practical interest.

A good water-metre, besides its application to the purpose of water-works, will be found a useful auxiliary to brewers, distillers, and liquid merchants generally; also, to engineers and to all engine proprietors; by furnishing a register of the water pumped into steam-boilers; from which a correct estimate may be found of the evaporative powers of the boiler, and the relative quantity of the fuel employed, independently of the working conditions of the engine.

The metre is required to fulfil the following conditions:

1. It must register correctly the quantity of water passed through the metre, either at high or low speeds.
2. It must not be affected by the pressure of a high column of water upon its working parts.
3. It must allow the water to pass through without obstructing or at intervals checking the same.
4. Its working parts must be protected against the effects of mechanical impurities or corrosive agencies in the water, so as to insure it continuous working without frequent attention.
5. It must be a cheap and compact instrument, adapting itself conveniently and locally to ordinary circumstances.
6. Its working and registering parts must be inaccessible to the employer, in order to prevent fraud.

The fulfilment of these conditions might at first sight appear an easy problem for a skilled mechanician, but the numerous and fruitless attempts that have been made at its solution have proved the real difficulty of the task. In order to combat these difficulties successfully, it is necessary to discriminate between those that are inseparably connected with certain principles of action, and those of mere detail of arrangements, or choice of material. All metres that have hitherto been proposed may be classed under the four following heads, viz:—1. Cistern or bucket-metres. 2. Piston-metres. 3. Metres by area of channel. 4. Metres by impact.

* From the Repertory of Patent Inventions, Sept., 1854.

Mr. Mead, of London, proposed a registering bucket-metre, of very simple construction, consisting of a mould or double bucket, divided equally by a cross partition and carried by a rocking shaft. Perpendicularly above this rocking shaft is the open mouth of the supply-pipe, for filling alternately the one and the other bucket. At the extremities of the buckets, small pockets are provided, that fill at the instant their respective buckets overflow, and being at the greatest distance from the rocking shaft, cause the filled bucket to overbalance the empty one, and discharge itself into the cistern below. The supply of water is regulated by means of a float and a cock. The rocking shaft gives motion to a counting apparatus by means of a ratchet and wheel.

Mr. Parkenson, of London, invented a bucket-metre, pertaining to its construction to the ordinary gas-metre, which is found to register the water passing through with great accuracy, and is actually used to a great extent in connexion with receiving cisterns.

The disadvantage of these metres is that they destroy the onward pressure of the water, and are, of necessity, encumbered by cisterns at elevations above the premises supplied.

The name "piston-metre" is intended to comprise all metres in which the fluid is measured by displacing a piston, a disk, or a diaphragm, and thereby filling a measured cavity.

The piston-metre in this respect resembles the bucket-metre, with the advantage of transmitting the onward pressure of the water, and of dispensing with the necessity of a cistern. On the other hand, it labors under great and peculiar disadvantages, partly on account of the valves and pistons which are employed being quickly destroyed by the sand and other impurities contained in the water, or broken by its impact against them, and partly on account of their great bulk and expense in proportion to the water measured.

It will only be neccesary to mention a few of the multitude of piston-metres that have been proposed, for the sake of illustration. Those of Lewis, and Taylor, both of Manchester, and of Messrs. Barr & Macnal, of Paisley, are examples of single cylinder-metres, with tumbler arrangements, to reverse the valves suddenly, in order not to check sensibly the column of water moving through the pipes. Captain Ericsson, of America, and Mr. Chrimes, of Rotherham, simultaneously proposed a metre, consisting of two cylinders working on cranks at right angles to one another, in order to equalize the flow through the pipes, and to be able to apply slide valves, worked by eccentrics, in place of the more complicated tumbler arrangements. Mr. Roberts, of Manchester, constructed, in 1851, a cylinder-metre, made to tumble or oscillate by the weight of the piston. Messrs. Bryan, Donkin, & Co., of London, invented, in 1850, a disk-metre: Mr. Parkenson, of Bury, and Messrs. Chadwick & Hanson, of Salford, have substituted india-rubber diaphragms for the piston, and the disk, respectively. Mr. Adamson, of Leeds, made a metre resembling the rotary engine, in which direction he has been followed by several others.

The last named metre is the only one of this class that has been practically used for several years (at Leeds), but it was finally superseded, on account of excessive wear and tear, and frequent stoppages.

A metre "by area of flow" presupposes a constancy of pressure, and knowledge of the time of continuation of flow. It is practically resorted to for measuring, approximately, large volumes of water, by passing it over an overflow, and taking into account the depth of water column, its breadth, and the time of flowing.

The great inconvenience of this system is illustrated by the fact that many houses in Paris require upwards of ten cisterns for the supply of the different inmates. Besides which, it is unjust, for it obliges every consumer to pay at a maximum rate.

Several years since (in 1845), the writer of the present paper invented a metre which measured by area of channel, and dispensed with the necessity of a cistern; registering the quantity of water actually passed through. It consisted of a square pipe, containing a common flat valve, which the water had to raise in order to pass through. The spindle of this valve passed through a stuffing box, and carried a lever which by its motion raised or lowered a driving strap upon two reversed cones. The cone, with its apex pointing downwards, received a regular motion by means of clock-work, while the reverse cone communicated motion received through a strap to a counting apparatus. When no water passed through, the flat valve was closed, and the clock-work stopped by means of a detent. The instant, however, the valve was raised by the passage of water, the clock-work was released, and a very slow motion was imparted to the counting apparatus; and in proportion as the flow increased, the strap was raised and the motion of the counting apparatus increased.

A metre differing only in its details from the above, has recently been brought out by Mr. Kennedy, of Kilmarnock.

The frequent necessity for winding up the clock movement rendered this metre unfit for general application. To obviate this, the writer thought of abstracting the motive power for the clock from the water itself, by introducing a screw propeller into the pipe.

Being advanced thus far, it became apparent that the valve and clock-work might be entirely dispensed with, if the propeller could be made to rotate in the precise ratio of the moving column of water, and to impart that motion directly to the counter.

Thus, the first step was made toward the production of a metre by impact, by which it is contended the conditions above enumerated of a perfect metre are most fully realized.

The writer considers it an essential condition of an impact metre, that the propelled vanes merely glide edgeways through the water, by partaking fully of its onward motion, without sensibly impeding or agitating the same.

These conditions are most fully complied with by a perfect screw suspended on two pivots, in the axis of the moving column of water. They are also fulfilled by a Barker's mill, or turbine of spiral blades, that yield to the motion of the water outward from a centre.

The correctness of the author's supposition was proved indirectly by the failure of an attempt made at about the period referred to, by Mr. Abraham, to register the water flowing through a pipe by means of a

screw propeller of irregular form, although suspended with great care between points of agate.

The same unsatisfactory result was obtained some years later by Mr. Tebay, of London, who formed his propeller by making radial incisions into a disk of brass plate, mounted upon a spindle, and by twisting each segment in the same manner, like the vanes of a windmill. He endeavored to counteract the inaccuracy of his propeller by introducing valves so contrived that the water should be able to pass only at a fixed velocity.

In order to obtain correct measurement by an impact metre, it is not sufficient that the propeller should yield equally in all its parts to the motion of the water, but it must also possess the power to overcome a uniform resistance by friction in its bearings, &c., without diminishing its proportionate rate of rotation at low speeds.

The apprehension of these difficulties deterred the writer, for several years, from proceeding, until the pressing want for a metre, to carry out some other improvements, induced him to construct, in 1850, the metre exhibited to the meeting; which metre, in point of accuracy of measurement and compactness, fully satisfied a committee of inquiry of the Manchester Corporation Water Works, by whom its adoption was recommended. The successful results obtained by this metre, which the writer had not even an opportunity to adjust previous to its official trial, were thought strong proofs in favor of the principle involved. He was indebted for the first execution of his idea, and some valuable suggestions, to his brothers at Berlin.

In attempting, however, to put the metre into regular service, under a working pressure of upwards of 200 feet column of water, subject to violent concussions, and acted upon by mechanical as well as chemical impurities in the water, he, and the manufacturers, Messrs. Guest & Chrimas, of Rotherham, had to encounter many serious difficulties, which finally determined them to adopt, for smaller metres, the more simple arrangement of a spiral curve, or Barker's mill.

One arrangement now adopted consists of an apparatus having a double screw or balance-metre capable of measuring 100,000 gallons per hour, or above two million gallons per day.

This metre is provided with a cylindrical casing, lined throughout with a brass tube, drawn to a precise gauge, and connected by its flanches to a line of piping of 8 or 9 inches in diameter.

The measuring apparatus contained in this casing consists of two hollow drums, which carry, on their circumference, the one a set of right-handed and the other a set of left-handed screw-blades. Conical blocks, armed with radial projections or guide-blades, are fixed at each end of the apparatus, extending nearly to the two screw drums, which are caused to rotate by means of bevel wheels. Two double inverted cones are provided, one at each end of the casing, for the purpose of directing the water towards the centre thereof.

The main spindle, carrying the upper bevel wheel, passes, through the hollow arm of a central bracket, into a close chamber, and carries an endless screw, which drives the counting apparatus.

The water enters the metre through a grating, which is provided to arrest large solid bodies that might obstruct the working of the apparatus.

The inverted cone at the inlet end of the metre, directs the current of water toward the centre, where it again spreads over the conical block, and, being directed parallel to the axis between the guide vanes, impinges obliquely upon the right-handed vanes of the hollow screw drum. The object of (figuratively speaking) kneading the current of water between the conical surfaces is, to destroy partial currents within the same; and in spreading it from the axis, to increase its leverage on the rotating drum. The diameter of the body of the drum is made slightly smaller than the diameter of the conical block, in order to protect the former from endway pressure of the moving column of water. Some clearance is allowed between the helical vanes and the surrounding casing; but the passage of water outside the vanes is effectually prevented by slight contractions of the water-way at both ends. In order to prevent wear and friction on the bearings, the body of the revolving drum is made hollow to such an extent, that the water displaced nearly balances the weight of metal. A screw drum of this description moves with a very gentle current of water, but it would, nevertheless, make a very imperfect metre if it were simply connected to the counter, inasmuch as the friction in the bearings and of the counter would retard it most at low speeds, and the friction of the vanes in gliding through the water (which increases in the ratio of the square of the velocity) would again greatly retard it at higl. speeds,—the maximum rate of measurement being obtained at a medium speed.

By the addition of the second or left-handed drum, these variations in speed are compensated. For the sake of illustration, let it be imagined, that both screw drums revolve independently of each other (of course in opposite directions), and that the second or left-handed one alone imparts its motion to the dial; let it also be supposed that the friction of both drums is the same;—the water, in meeting the oblique vanes of the first drum in a direction parallel to the axis, will be deflected from its straight course proportionally to the resistance to rotation of the drum, say an angle of 1°. Pursuing its fresh course, it will strike the left-handed screw blades of the registering drum, in an angle at 1° more obtuse than the previous; and, being deflected by the resistance offered through 1° in the opposite direction, the water will pass out in a direction parallel to the axis, and, consequently, a true rate of measurement will be obtained. By coupling both drums rigidly together by bevel gearing, a great practical advantage is obtained, namely, that of one drum assisting powerfully to overcome an obstruction offered to the other. Let it be imagined, for instance, that a pebble or piece of vegetable matter has wedged itself between the casing and tip of the vane of the first drum, so as to stop it entirely, and to force the column of water passing through into the helical course; the water would then impinge upon the left-handed vanes of the second drum rectangularly (supposing the inclination of the reverse vanes to be at an angle of 45° to the axis), and expend its entire momentum upon it; the effect of which would be added to the impact on the first drum through the bevel gearing, to overcome the obstruction. The motion is conveyed to the counter by the upper bevel wheel; but the lower wheel is added to strengthen the connexion between the two drums, and to relieve all the spindles from pressure. Before leaving the metre, the current of water

is again contracted between conical surfaces, for the same purpose as before, namely, to equalize its flow.

In calculating the quantity of water that will effect one complete revolution of the screw-drums, it is necessary to compute the clear net area between them and the external casing,—supposing all the surfaces to be covered with a film of stationary water (by adhesion), $\frac{1}{140}$th part of an inch in thickness, and to multiply the same by the pitch of the screw. The correction for adhesion amounts to an inappreciable quantity for large metres, but constitutes a considerable per centage in the calculation for small metres.

The difficulties that have been encountered in the manufacture of this metre apply principally to the spindles. Although relieved from all constant pressure, they have nevertheless to maintain the drums in their central position, and to resist a strain endways, caused by the mere friction of the water in passing along the vanes;—they have, in consequence, to be made of hard metal. A hard bronze was found to be the most suitable metal, and answers well for metres of large size; but it is difficult to produce the spindles for small metres of that metal.

The difficulty at first experienced of producing screw-drums of correct shape and uniform size, without incurring a large amount of workmanship, was successfully removed by casting them, and many other parts, in metallic moulds. The manufacturers also tried gutta-percha, which, being slightly lighter than water, was, with its spindle, exactly equal to the weight of water which it displaced; but it could not be made sufficiently correct and rigid in the vanes. After some time, the manufacturers succeeded in casting drums for the larger metres of bronze, and in dry sand, with great accuracy.

The calcareous matter in water deposits only on the surfaces of brass that are not exposed to the current. It exercises, therefore, no effect on the measuring surface, but if allowed to penetrate into the chamber of the counting apparatus, it incrusts the small wheels and spindles, and causes them to break or wear rapidly. To alleviate this, a lower division of the box containing the counting apparatus, is filled, before it leaves the manufactory, with pure olive oil, which affords a complete and continuous protection to the wheels.

For metres having a supply pipe of less than two inches diameter, the spiral form of propeller, or Barker's mill arrangement, is adapted; except in cases where the water acts impulsively, as, for instance, in supplying steam-boilers by means of pumps,—where the double screw metre is the only one applicable.

In the second arrangement of the metre before alluded to, the water enters through a side pipe, and traversing a cylindrical grating, covered with wire gauze, it passes downward through a central funnel, into the propeller; and issuing from two apertures of its circumference, it passes into a chamber leading to the exit pipe.

At the bottom of the propeller a chamber is formed filled with oil through small apertures at the bottom, and sealed close, leaving only an eye in the centre, through which an upright stud of bronze enters, which, with its steel point, abuts against a steel plate in the bottom of the propeller. The lower chamber of the counting apparatus box is formed of

white metal, cast in one piece with the wire gauze grating, and it is filled completely with oil.

Theoretically speaking, this metre is less perfect than the compensating screw-metre, but it possesses the great advantage of containing only a single bearing that is at all liable to wear, and that bearing is effectually protected from the action of the water. The practical effects of this simplification of parts has been, that, of 150 metres of this description that are at work, not one has as yet been returned disabled or inaccurate.

Mr. Adamson, of Leeds, has lately projected a metre with two sets of spiral blades, upon the principle of a turbine; the inner set being stationary, and the outer set revolving. This metre also gives a very good result.

Another kind of a metre lately brought out by Mr. Taylor, of Manchester, having a revolving horizontal drum or water-wheel, acts partly by jet and partly by impact; but on this account it appears to the writer imperfect in principle.

It has been argued before that no accurate measurement can be effected by the application of jets. To avoid them in the spiral metre, it is essential to make the area of the outlet larger than the area of the supply-pipe. Nevertheless, the nature of a jet still manifests itself to some extent by increasing the rate of the metre at high velocities. This defect has, however, been effectually counteracted by the application of rotating flies or drag-boards fixed to the outer edge of the propeller, which offer a resistance increasing as the square of the velocity, and can be regulated to equal the effect obtained by the jet. They offer also great facility in adjusting the absolute measurement of the metre.

In order to insure the efficiency of each metre, it is necessary to test the same under variable pressures, and with considerable volumes of water. To this point the manufacturers, Messrs. Guest & Chrimes, have devoted great attention. The apparatus they employ consists of a large cistern, 40 feet high, and a second cistern below, capable of containing 1000 gallons, and accurately graduated throughout. A set of pipes which have been proved to transmit given quantities of water per minute, under the pressure from the upper cistern, is provided, and from 8 to 12 metres to be tested are coupled in a line, one behind another, to a pipe leading from the upper cistern to the outlet of the metres. The test pipes are then alternately connected; a uniform quantity of water, as shown in the cistern, is passed through each pipe, and the number of gallons indicated on the different counters is noted in a book opposite to the permanent number of the respective metres. An extract from this book shows how nearly correct a measurement is obtained.—*Inst. Mech. Eng., Birmingham.*

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*A Monster Fly-Wheel.**

Mr. Clay described the large fly-wheel at the Mersey Forge, which was stated to be the largest in the world. In the rolling boiler plates there is a certain limit to the speed at which the roller should travel—in

* From the Lond. Civ. Eng. and Arch's. Jour. November, 1854.

other words, the number of revolutions made by the roller are very few when compared with the rollers of other descriptions of iron; and it was therefore necessary in a mill where direct action was required, that a fly-wheel should be constructed of sufficient size and weight to have, with a small number of revolutions, sufficient momentum to overcome the ordinary shocks of rolling large plates of iron. This could only be done by increasing the diameter of the wheel to such an extent that the rim should have the requisite momentum. With this view a wheel has been made of 35 feet diameter, and weighing about 60 tons, about 24 tons of which is disposed in the rim, which is intended to run with a velocity of about 4500 feet per minute, in making about 38 revolutions. Great care was necessary, in a wheel of such magnitude, that the various parts should be well and securely fastened together, and after finishing the drawing of the wheel it was submitted to the authority of Mr. Fairbairn, who pronounced it as perfectly safe at a velocity of 14,000 feet per minute—number of revolutions, 120.

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*On the Flow of Gas Through Pipes.**†

(Continued from page 47.)

The next experiments which we shall examine comprise a series of six given by Mr. Clegg in his work on Gas-Lighting.

Table showing the Quantity of Gas of Specific Gravity ·420 *discharged per hour, according to Mr. Clegg's Experiments, from a* 6*-inch main, with a pressure equal to half an inch of water.*

Length of pipe, in yards.	Quantity discharged per hour, in cubic feet.	Value of x Calculated from the Equation $x=\frac{Q\sqrt{Lg}}{D^2\sqrt{H}}$
3·46	44280	2100
4·5	38838	2100
7·5	30000	2096
16·5	20270	2099
25·	16460	2099
34·2	14080	2100
		6) 12,594
The coefficient derived from Mr. Clegg's experiments on a 6-inch main		2099

Mr. Clegg gives a single experiment with a 4-inch main, in which he found with a pressure equal to 3 inches, 852 cubic feet of gas of specific

* *Hughes' Treatise on Gas Works.* London: J. Weale.

† From the London Artizan, April, 1854.

gravity ·398 were delivered from a main 10,560 yards in length. The coefficient derived from this experiment is

$$\frac{852 \times \sqrt{10560 \times \cdot 398}}{16 \times \sqrt{3}} = 1993.$$

Most of the following experiments are taken from a paper by Mr. Pole. In the last column, the value of the coefficient x has been calculated as before; and in order to present a clear view of the way in which this coefficient varies with the diameter of the main, the result of the previous experiments are repeated in the table.

No.	Diameter of pipe, in inches.	Length of pipe, in yards.	Pressure, in inches of water.	Specific gravity of gas, air being 1.	Quantity discharged in cubic feet per hour.	Value of x calculated from Equation $x = \frac{Q\sqrt{l.g}}{D\sqrt{H}}$
1	0·5	10	1·25	·4	120	860
2	0·5	59	1·25	·4	60	1043
3	0·62	41	1·34	·559	99	1065
4	0·62	62	1·34	·559	83	1096
5	0·62	93	1·34	·559	74	1198
6	0·62	119	1·34	·559	57	1045
7	0·62	138	1·34	·559	53	1047
8	2·00	25	0·5	·528	1630	2094
9	4·00	10560	3·0	·398	852	1993
10	6·00	3·46	0·5	·42	44280	2100
11	6·00	4·5	0·5	·42	38838	2100
12	6·00	7·5	0·5	·42	30000	2096
13	6·00	16·5	0·5	·42	20270	2099
14	6·00	25·	0·5	·42	16460	2099
15	6·00	34·2	0·5	·42	14080	2100
16	8·00	1842	0·7	·4	6000	3042
17	10·00	100	3·00	·4	120000	4382
18	10·00	1760	3·00	·4	30000	4596
19	18·00	1760	1·00	·4	66000	5405
20	26·00	3130	·8	·42	103000	6173
21	26·00	4300	2·25	·42	17500	6990
22	26·00	4300	0·475	·42	80000	7255

Returning, now, to formula (4,) according to which Mr. Clegg's tables are calculated, on the supposition that x is equal to 2096, we shall find on examining the above table, that this coefficient will not correspond with any of the experiments made on pipes of less diameter than 2 inches or greater than 6 inches. For instance, the formula used by Mr. Clegg would give more than double the true quantity delivered when applied to a pipe half an inch in diameter, and when applied to a main of 26 inches, would give a result less than one-third of the true discharge from this main. To make this more clear, let us suppose it be required to calculate the delivery of gas according to the experiments above cited. For a half-inch pipe we have two experiments, one of which gives a coefficient of 860 and the other 1043, the mean of which is 952. Mr. Clegg's coefficient, we have already seen, is 2096, and the coefficients derived from experiments on a 26-inch main are 6173, 6990, and 7255,

the mean of which is 6806. Hence, if we were to establish a rule for finding a quantity of gas delivered,

According to experiments on the ½-inch pipe, the formula would be

$$925\ D^2\sqrt{\frac{H}{Lg}}$$

According to Mr. Clegg's experiments, it would be

$$2096\ D^2\sqrt{\frac{H}{Lg}}$$

According to experiments on the 26-inch main, it would be

$$6806\ D^2\sqrt{\frac{H}{Lg}}$$

In examining these apparently irreconcileable results, the principal feature which immediately strikes us is, that the friction of the gas in passing through the pipes is not represented or taken into account in any of the formulæ. Now, it appears, that comparing the two coefficients 952 and 6806, one of which is seven times greater than the other, that a 26 inch pipe will deliver seven times the quantity due to its area as compared with a half-inch pipe. This is very nearly in the proportion of the square roots of the diameters, for

$$952 : 6806 : : \sqrt{\cdot 5} : 5{\cdot}055.$$

The root of 26 being 5·099, this ought to be the fourth term in the above proportion ; but, considering all the circumstances of the case, the correspondence is tolerably near.

It would be wearisome to go through a similar comparison with all the other experiments. It may suffice to say, that no other form of expression agrees so well with the experiments as that in which the quantities delivered are further increased as the square roots of the diameters.

I therefore propose a formula in which the square root of the diameter shall be used as a multiplier, and will add a table showing the results of all the preceding experiments when compared with the quantities calculated in this way.

It will be advisable to take the experiments on the 26-inch main as the most trustworthy ; and here, as we are going to introduce a new multiplier equal to 5·099, the square root of the diameter, we must of course divide the coefficient 6806 by 5·099, in order to find the new coefficient.

Hence, $\frac{6806}{5{\cdot}099} = 1335$, the new coefficient required. The general formula, then, which I shall propose for calculating the quantities of gas delivered through pipes, in the present state of our knowledge, is

$$1335\ D^2\sqrt{\frac{HD}{Lg}} \quad . \quad . \quad . \quad . \quad . \quad (6)$$

Table showing the Quantities of Gas delivered by Experiment and Theory in the following series of Experiments, which are numbered to correspond with those in the Table on page 122.

No.	Quantity by experiment.	Quantity by calculation.	No.	Quantity by experiment.	Quantity by calculation.
1	120	132	12	30000	46862
2	60	54	13	20270	31527
3	99	97	14	16460	25124
4	83	80	15	14080	22011
5	74	65	16	6000	7433
6	57	57	17	120000	115611
7	53	53	18	30000	27554
8	1630	1181	19	66000	69206
9	852	1130	20	103000	113710
10	44280	68726	21	175000	162443
11	38838	60556	22	80000	74453

In this comparison of theoretical quantities with actual discharges, it will be seen that considerable differences exist. With the exception of experiments 9 to 15, however, the differences are perhaps not more than might be expected when the numerous distributing causes are taken into account. In the first place, the mains may not have been strictly horizontal, although assumed to have been so by the authors of the experiments. Secondly, there may have been bends or angles in the course of the main, as in the case of experiment No. 9, which is recorded in Mr. Clegg's Treatise on Gas Lighting, and was made on a pipe nearly six miles in length, the discharging extremity being brought round in a large circle nearly to the place where the gas first entered the pipe. In this experiment it will be observed, the theoretical quantity is more than 30 per cent. in excess of the actual discharge.

By far the greatest variation, however, is found in Mr. Clegg's experiments on 6-inch pipes (experiment 10 to 15,) where the results by theory are about 50 per cent. more than by experiment. I am unable to account for this variation, which does not exist to any thing like the same extent in any of the other experiments.

The extreme shortness of the lengths of main employed by Mr. Clegg, may have exercised some influence by admitting atmospheric air to resist the flow of the gas.

For those, however, who are disposed to place confidence in Mr. Clegg's experiments, to the exclusion of others, it will be readily competent to derive a coefficient from Mr. Clegg's experiments, by dividing the number in the last column of table at page 122 by 2·449, the square root of 6.

The tabular number in Mr. Clegg's experiments being 2099, we have $\frac{2099}{2{\cdot}449}=857$, the coefficient to be used according to Mr. Clegg's experiments.

The conclusion to be drawn from a review of all the experiments which

have been made on the flow of gas through horizontal pipes is this, that taking friction and every thing else into consideration, the quantity is equal to x A, where

$$A = D^2 \sqrt{\frac{HD}{Lg}},$$

and where x is the coefficient to be determined by experiment.

Let Q be the quantity determined by experiment, then we have

$$x = \frac{Q\sqrt{Lg}}{D_2\sqrt{DH}}$$

Those who desire a more exact method of determining the quantities of gas which will be discharged through pipes of various diameters, must be content to wait for the determination of x by means of an extensive and accurate series of experiments, which, by giving the quantity of gas having a known density discharged through mains of certain length and diameter under a known pressure, will afford the means of calculating the value of x, or the coefficient to be used in all other determinations.

I think it right to remark, that in Mr. Pole's very admirable paper * from which I have quoted some of the preceding experiments, the author arrives by an entirely different method at a formula very nearly identical with that which I have given.

The formula which Mr. Pole proposes for gas is

$$1350\ D^2 \sqrt{\frac{HD}{Lg}},$$

the only difference being that his coefficient is 1350 instead of 1335. Mr. Pole adds in a note, that in some recent experiments on a 9-inch main giving the discharge under various pressures, the results would require his coefficient to be reduced to 1150; but goes on to say that it would not be judicious to adopt such an alteration for general use, unless confirmed by other experiments on pipes of different diameters.

We now come to the third division of the subject, namely, where mains are laid with an inclination above or below the point of supply. We have here again to regret the insufficiency, or rather the entire absence, of such experiments as would elucidate the inquiry. The rule which appears to be generally adopted is this, that every variation in the inclination of the main causes a corresponding difference of pressure at the rate of one-hundredth of an inch for every foot of rise or fall. Thus, when a main rises 10 feet above a datum line at which the pressure is known, an increase of pressure is obtained equal to one-tenth of an inch; and, on the other hand, when a main is at any point 10 feet below such a datum line, the pressure is diminished to the extent of one-tenth of an inch.

* Published in the *Journal of Gas Lighting*, for June, 1852.

For the Journal of the Franklin Institute

Steam Navy of the United States.

At a time like the present, when the United States may, at a moment's notice, be brought in contact with some of the naval powers of Europe, we may, with propriety, examine into that branch of our Navy, upon which we must rely in case of such collision. Any fleet that ventures into action without the aid and assistance of steamers, which shall form a part of it, and a large part, too, will only do so to be defeated, for the ability to take position has always been considered an element of success. There has been such an objection to any increase of the Navy for several years past, that Congress has preferred to spend millions in repairing worn-out hulls of sloops, frigates, and ships of the line, rather than to build steam vessels suited to the wants of the service, and thus, old vessels, whose defect in model alone should have condemned them long ago, have been repaired at a cost equal to that of their original construction; a system of practice, not to be commended for its economy or durability. The present Secretary of the Navy, Mr. Dobbin, has succeeded in satisfying the Congressional Committees on this subject, and a feeling, more in unison with the interests of the Navy, is becoming prevalent in both Houses of Congress, and if his views are carried out, he will leave his department, when he retires from it, in a condition that will reflect credit on his administration.

Of steamers, that are already built and in service, we have as follows:

The	Mississippi,	side wheel,	1788	tons,	10	guns.
"	Susquehanna,	" "	2436	"	10	"
"	Powhattan,	" "	2419	"	10	"
"	Saranac,	" "	1426	"	8	"
"	San Jacinto,	Propeller,	1426	"	8	"
"	Princeton,	"			8	"
"	Fulton,	side wheel,			5	"
"	Michigan,	" "			1	"

In addition to the above, we have a few small craft that might possibly be of use on coast duty, but are unfit for foreign service.

Congress, at its last Session, authorized the construction of six first class war steamers; and at a board of officers, held at Washington, it was decided that they should be sailing ships *with auxiliary screw power;* that the propeller should have two blades, and be arranged so as to hoist out of water when the vessel was under canvas. Immediately after this decision, Mr. Martin, Engineer-in-Chief of the Navy, was sent over to Europe to examine into the merits of the several forms of screw machinery, and particularly into the different methods of disconnecting and hoisting the screw. On his return, a board of officers was convened at Washington, consisting of Mr. Lenthall, Chief of the Bureau of Construction; Mr. Martin, Engineer-in-Chief; Messrs. Wood, Hunt, and Everett, Chief Engineers; and Mr. Copeland, Consulting Engineer to the Navy. Previous to their meeting, plans and proposals had been asked for machinery, and it was with particular reference to this business, that the board was convened. As these vessels have two gun decks, and a capacity to carry fifty 8 and 10 inch guns, it became necessary to exercise

much caution, so that a proper capacity should be allowed to each department. Thus, 50 guns involve a certain number of men; the number of men regulates the quantity of water, provisions, etc.; all these calculations were made by Mr. Lenthall, and the utmost space that could be allowed to the machinery and coal, was 60 feet in length by the width of the ship under the lower deck, which was 17 feet from face of timbers. The Board decided upon giving to each vessel two direct action engines, with horizontal cylinders, each having an effective diameter of 72 inches and a stroke of 3 feet, connecting at right angles to one shaft, having cranks forged on. Four boilers, having in all a grate surface of 320 square feet, and a heating surface of 11,500 square feet. Propellers to be 17 feet 4 inches diameter, and with 2 blades, 23 feet pitch. The plans and propositions of the following parties were accepted, and contracts made with them for the machinery, to be made from their own designs, the same being warranted by them for six months after the trial trip.

Anderson, Delany & Co., of Richmond, Va., build the machinery for the *Roanoke* and *Colorado*, at Norfolk; Merrick & Sons, of Philadelphia, for the *Wabash*, at Philadelphia; Robert P. Parrott, (West Point Foundry,) for the *Merrimac*, at Boston. The machinery for the *Minnesota*, at Washington, is to be built at the Government shops, in the Navy Yard at that place, from designs prepared by Mr. Martin, Engineer-in-Chief. The *Roanoke*, *Colorado*, and *Minnesota*, will have trunk engines, in general design, similar to those of Penn & Son, of Greenwich. The *Wabash* will have engines somewhat similar to those of the French steamer *Pomone*. The *Merrimac* will have engines with two piston rods to each cylinder, similar to those of the English steamer *Amphion*.

The boilers of all the vessels are alike, and have plain arches below, returning between vertical tubes above; these tubes are 3 feet 3 inches long, 2 inches outside diameter, and of brass; each boiler has about 1500 tubes, and the construction is such, that any tube proving defective, it may be removed without disturbing the others; this form of boiler, originated with Mr. Martin, Engineer-in-Chief, and has been secured to him by patent. As to its merits, it is only necessary to say, that while every contractor was at liberty to adopt any form of boiler containing the amount of fire and grate surface required, yet, all have adopted this from choice.

The following are the principal dimensions of these vessels:

Length between perpendiculars,			265 feet	8 inches.
" from knight-head to taffrail,			287 "	7 "
Beam, moulded,			50 "	2 "
" outside of plank,			51 "	4 "
Depth of hold to gun deck,			26 "	2 "
" " " spar deck,			32 "	7 "
Tonnage,		3200 tons.		

They are being built in the most substantial manner, having a live oak frame diagonally plated with iron inside, and white oak keel, keelsons, and plank. Much activity is being used in their construction, and all of them will, no doubt, be launched by the first of October next, and in commission in four months from that date, that being the time required by the contractors after the launching of the vessels.

Having described the above five ships, the models of which were furnished by Mr. Lenthall, I will now turn to the *Niagara*, which, differing

in very many respects from the others, requires special notice. The hull of this vessel is being constructed from the designs and under the immediate supervision of Mr. George Steers, known as the builder of the yacht *America*. Mr. S. has been appointed a Naval Constructor for that purpose. She is building at the Brooklyn Navy Yard, and has the following principal dimensions:

Length over all,	345 feet.
" on load line,	333 "
Beam outside of plank,	55 "
Depth of hold to spar deck,	31 "
Tonnage,	4800 tons.

This vessel is to have but one gun-deck, and will carry 12 guns of the largest size. This reduction of armament, combined with her increased size, allows of a material increase of the space allotted for machinery, and the Board decided to put in 3 direct action horizontal engines, having cylinders of 72 inches diameter, and 3 feet stroke, all of them being connected to one shaft, having the cranks forged on it at an angle of 120° with each other. Boilers, to be 4 in number, and to contain 480 square feet of grate surface, combined with 18,000 square feet of heating surface.

Having been thus particular in giving the dimensions of these vessels, I wish now to make some remarks in relation to their speed. The first five ships are almost identical in form, although there is a slight difference in their model; if we compare them with the Collins' line of steamers, which are 400 tons smaller, we find that these vessels have less than $\frac{5}{8}$ths the power of the steamers of that line, and this gives us a starting point from which to ascertain the speed. The average summer passages of the Collins' line give a speed of $12\frac{1}{2}$ knots per hour. Now, the midship section of those ships is about 913 square feet, while of these, it will be 1129 square feet; therefore, if the models were equally good, these vessels would require $\frac{1}{5}$th more power than the Collins' line to equal them in speed, but as such is not the case, and their power is limited to less than $\frac{5}{8}$ths the amount belonging to those steamers, it will be found, on calculating the several points of difference that if the models were equal, the speed due to these ships would be $9\frac{3}{4}$ knots at the time the others make $12\frac{1}{2}$ knots. This $9\frac{3}{4}$ knots will be reduced by the fact that these vessels have very full models compared with the Collins' ships, and that their propelling power is a screw, instead of the side wheel, the latter being unfit for war steamers; so that, making fair allowances for these differences, 8 knots in fair weather, may be assumed as the speed due to these steamers.

The *Niagara*, in model, is equal, if not superior, to the Collins' line. Supposing her equal, and making no deduction for difference of effect between side wheels and propeller, her speed should be $11\frac{1}{3}$ to their $12\frac{1}{2}$ knots. It will be observed, that I have not alluded to *trial trip* speeds, or *fair wind* passages; but to regular speeds under steam, in fair weather at sea.

In addition to these vessels, the Department are building at Portsmouth, N. H., in place of the line of battle ship *Franklin*, condemned, a large screw steamer of 50 guns, but no progress has been made in her machinery.

There is also building, by Mr. Stevens, at Hoboken, opposite New York, a floating battery of iron of large size. This affair has been many years in slow progress, and the time of its completion is yet far distant.

In addition to all the vessels, to which I have alluded, the Secretary of the Navy proposes to build 6 screw steamers of about 1500 tons. This matter is before Congress, and appropriations for their construction will, no doubt, be made the present Session.

Supposing this to be done, we shall then have, including the floating battery, 22 steamers, a number, which, while it will not compare with the navies of England or France, still, will make a respectable show, and would, no doubt, be heard from in any naval action in which they took a part. B.

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*Electro-Magnetic Engraving Machine.**

This machine is somewhat on the principle of the well known planing machine. The drawing to be copied and the plate to be engraved are placed side by side, on the movable table or lid of the machine; a pointer or feeler is so connected, by means of a horizontal bar, with a graver, that when the bar is moved, the drawing to be copied passes under the feeler, and the plate to be engraved passes in a corresponding manner under the graver. It is obvious that in this condition of things, a continuous line would be cut on the plate, and, a lateral motion being given to the bed, a series of such lines would be cut parallel to and touching each other, the feeler of course passing in a corresponding manner over the drawing. If, then, a means could be devised for causing the graver to act only when the point of the feeler passed over a portion of the drawing, it is clear we should get a plate engraved, line for line, with the object to be copied. This is accomplished by placing the graver under the control of two electro-magnets, acting alternately, the one to draw the graver from the plate, the other to press it down on it. The coil enveloping one of these magnets is in connexion with the feeler, which is made of metal. The drawing is made on a metallic or conducting surface, with a rosined ink or some other non-conducting substance. An electric current is then established, so that when the feeler rests on the metallic surface, it passes through the coils of the magnet, and causes it to lift the graver from the plate to be engraved. As soon as the feeler reaches the drawing, and passes over the non-conducting ink, the current of electricity is broken, and the magnet ceases to act, and by a self-acting mechanical arrangement the current is at the same time diverted through the coils of the second magnet, which then acts powerfully and presses the graver down. This operation being repeated until the feeler has passed in parallel lines over the whole of the drawing, a plate is obtained, engraved to a uniform depth, with a fac simile of the drawing. From this a type-metal cast is taken, which, being a reverse in all respects of the engraved plate, is at once fitted for use as a block for surface printing. The machine is the invention of Mr. William Hansen, of Gotha.

Journ. of the Soc. of Arts.

* From the London Athenæum, June, 1854.

Specification of Patent granted to WILLIAM *and* JOSEPH CLIBRAN, *for certain improvements in apparatus for regulating or governing the supply or pressure of gas as it is conducted from the main to the burners.*—[Sealed 1st March, 1854.]

This invention consists in a novel construction and arrangement of apparatus for obtaining an even amount of gas whilst passing from the main to the burners for consumption, and consequently, an equality of light, whatever may be the variation of the pressure of the gas. The regulation of the supply from the main to the burners is effected by means of a slide-valve or disk-valve (the slide-valve being preferred), formed by two corresponding surfaces placed together between the branch inlet-pipe from the main and the branch outlet-pipe to the burners. These slide-valves have suitable apertures for the passage of the gas, so arranged that when the apertures are open, the gas will pass freely; but as, by shifting the position of the slide-valve, the apertures may be gradually closed or opened to the full extent, so the quantity of gas allowed to pass from the main to the burners is regulated or governed. The continuous opening and closing of the gas-passages in this slide-valve is effected by the variable pressure of the gas acting within a small gasometer, after the gas has passed the valve; so that as the pressure increases, the gas rising within the gasometer, will cause it to rise, and, by any simple arrangement of connexion or gearing, to open or close the apertures for the flow of the gas, and thus regulate the supply to the burners for combustion.

Fig. 1.

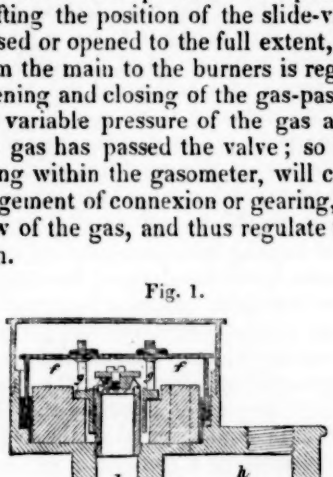


Fig. 2.

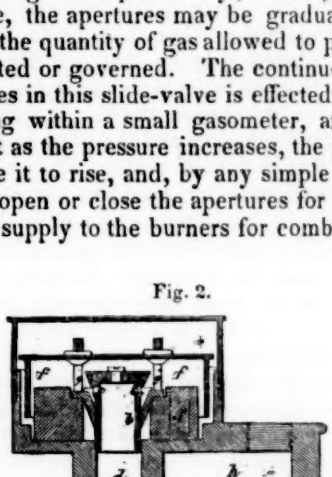


Fig. 1. exhibits a slide-valve of peculiar construction, the upper portion of which *a*, forms the frustrum of a cone. Around this, the collar *b*, fits, and rises and falls; thereby opening and closing the orifices or openings *c*, *c*, *c*, of the frustrum-shaped slide-valve. Fig. 2, represents a similar valve; and the same letters of reference refer to corresponding parts. The action of this improved apparatus is as follows:

The flow of the gas from the main enters through the tube *d*, directly to the centre or interior of the valve, not in its line of direction operating on any one particular portion of the surface of the valve or other mechani-

* From the Repertory of Patent Inventions, Dec. 1854.

cal equivalent, as heretofore has been the case, but in the interior of the valve; distributing an equal pressure on all sides (that is,—radiating from the centre of the said valve). From the interior of the valve the gas passes through the perforations or openings *e*, *e*, *e*, in the direction of the arrows, into the small gasometer or chamber *f*, connected by two small pendants *g*, *g*, with regulating screws at their upper ends, to the collar *b*. The gas from the gasometer *f*, then passes the openings shown by dotted lines at *j*, and, through the pipe *h*, to the burners: in both figures the valves are shown open. Supposing, now, the gas to be at a higher pressure within the valve than desirable to be supplied to the burners, the gasometer *f*, in accordance with its previous adjustment, will raise or elevate the collar or valve *b*, thereby partially closing the outlet space and regulating the equal pressure at the burners: but should the pressure within the valve, and, of course, in the main, become less, then the gasometer *f*, must fall, and the free flow of gas be allowed proportionate to such fall. It will be evident now that, from the peculiar construction of the valve, whatever the pressure of gas in the main, it must be equally diffused over the entire inner surface of the collar *b*, *b*, or of the shutting-off part of the valve; whereby extreme regularity of action is maintained.

The patentees claim, First,—the peculiar construction, employment, and use of an apparatus for regulating or governing the supply of pressure of gas as it is conducted from the main to the burners; having a central slide-valve through which the gas radiates, and thereby causes an equal pressure on all parts of the slide-valve and gas-holder, and also produces the required perpendicular lift of the same, in the manner and for the purposes above particularly set forth and described; such valve being placed in the regulated gas, in contradistinction to the valves of all other known gas-regulators, the valves of which have been invariably placed in the current of the irregulated gas; by which means a valve is obtained which offers no resistance either to the action of the regulating surfaces or to the gas-holder. Secondly,—the peculiar construction or arrangement of an apparatus for governing or regulating the passage of gas, in which the necessary regulation of the gas and the supply of the same for distribution to the burners is effected in one chamber, which causes its operation to be more sensitive to the variations of the pressure in the main, or to the shutting off of the supply of gas to the burners.

For the Journal of the Franklin Institute.

Ventilation of the Fire-Rooms of Steamships. By B. F. Isherwood, Chf. Eng. U. S. N.

The proper ventilation of the fire-rooms of large steamships has become a matter of considerable importance, in view, not only of the comfort and health of firemen, coal-heavers, and engineers, but also of the efficiency of the boilers:—for, unless a rapid and free supply of cold air can be furnished to the furnaces, the consumption of fuel and the consequent production of steam will fall short of what it would be under that condition; and it is rare, indeed, to find a boiler producing the supply desired

even under the most favorable circumstances. But, it is chiefly for the purpose of diminishing the great heat of the fire-rooms of large steamships, which, being situated in the bottom of the hold, are badly supplied with cold air, and the means of rapid exit for the air highly heated by the radiation from the boiler, that free ventilation is of the first consequence. None but those who have stood watches in the confined fire-rooms on the keelsons of our large men-of-war steamships, can appreciate how intolerable is that heat, and how destructive it is to the physical energies and health of those subjected to it:—the heat in the fire-rooms of steamships is what is called "moist heat," and it is much more oppressive and difficult to be endured, than the same degree of temperature of "dry heat."

While considering this subject of ventilation for the fire-rooms of steamships, in the case where the boilers are set athwartships, facing each other, and having the fire-room extending fore and aft the ship between them, as is now the general practice in all the new British steamers whose breadth of beam will admit the arrangement, and, where the smoke chimney is placed over the centre of the fire-room,—it occurred to me, that by placing a pipe inner and concentric with the smoke pipe, open below to the fire-room and above to the atmosphere, as shown in Plate I. Fig. 1, the means would be provided at very little expense of money, materials, or space, for the rapid and free exit of the heated air of the fire-room. For the temperature and height of the surrounding smoke pipe would always cause a powerful ascensional column of air within the inner air pipe, and continuously deplete the fire-room with great rapidity. The supply of cold air should be furnished at the two ends of the fire-room, through a chute or box descending to within three or four feet of the fire-room floor, so as to insure delivery at or about the level of the ash-pits. With this system of ventilation a great decrease of the temperature of the fire-room would be obtained, together with the concomitant advantages of comfort, not only to the engineer force, but to the whole ship, and also a considerable increase in the steam producing power of the boiler.

It is evident, that with the general system, shown in Fig. 1, a telescopic arrangement of chimney, can be had by joining the movable parts of the smoke and air pipes at their upper extremity alone, thus allowing the movable part of each pipe to descend within its corresponding lower or fixed part.

This system of ventilation can also be used in case of boilers extending fore and aft the ship, with the fire-room lying athwartship, when the smoke pipe is placed at the fire-room end of the boiler, as in single return tube and flue boilers, by curving the inner air pipe to an elbow and debouching it horizontally into the fire-room.

At first, it seemed difficult to arrange a damper in a smoke pipe containing an inner pipe; but a little reflection led me to the system of damper, sketched in Figs. 2, 3, and 4. In this system, the damper is divided into two parts, each part movable on its own axis, which axis passes close by the side of the inner pipe.

Fig. 2 shows a cross section of the smoke and air pipes, and a top view of the dampers in a closed position; the black space indicate that

portion of the cross area of the smoke pipe not covered by the dampers, for it is evident, that with this arrangement the entire area cannot be covered, the vacant spaces being the two segments of a circle having for arc a part of the periphery of the smoke pipe, and for chord, the straight line connecting the points where the axis of the dampers intersect the periphery of the smoke pipe. These small vacant spaces are practically no disadvantage, for the complete closing of a damper is never resorted to on account of the heat and coal gas it would force into the fire-room. The manner of moving both dampers, simultaneously, by one operation, is very simple, and so plainly shown, in Figs. 3 and 4, as to require no detailed description. Fig. 3, shows the position of the links and hand rope when the dampers are closed. Fig. 4, shows the position of the same when the dampers are open. It will be observed that the axis divides the damper unequally, giving a larger area upon the outer than upon the inner side, which is required in order that the dampers may assume the vertical position when the hand rope is slackened.

I am, however, of opinion, that ash-pit doors and not a damper in the chimney are the proper means of stopping the supply of air to the furnaces. The great recommendation of a chimney damper, will be found in its convenience, for it allows the draft of all the furnaces to be stopped at once by one operation; while, on the contrary, if ash-pit doors are used, the closing of each door requires a separate operation, involving more time and trouble, not to mention the inconvenience of the doors themselves, protruding into the fire-room. Nevertheless, ash-pit doors permanently hinged in pairs on the sides of the ash-pits, are doubtless the best mode of stopping the draft and quickly cooling the boiler; for while they entirely prevent the access of air below the grates and to the fuel, the furnace doors being opened, allow the ingress of a large body of cold air, which rushes in over the fuel, through the flues and up the chimney, thereby ventilating and cooling the fire-room also, instead of heating it, as the closing of a damper in the chimney would do, by throwing out into the fire-room the heat of the furnaces and the gases of the fuel.

Specification of Patent granted to DAVID HULETT, *for improvements in Gas Regulators for regulating the supply of gas to the burner,—being partly a communication.*—[Sealed 4th January, 1854.]*

The object of this invention is to regulate the supply of gas as it issues from the main to the burner, and prevent fluctuation in the height of the flame, notwithstanding any difference that may occur in the pressure of the gas in the main.

The improved apparatus consists of a cast iron vessel with inlet and outlet passages for the admission and emission of the gas: the inlet is covered by a valve, the edge of which dips into a groove containing mercury: this renders the joint perfectly gas-tight without impeding the motion of the valve, which is hung in such manner as to move with the

* From the Lond. Journ. of Arts, Dec. 1854.

slightest variation of pressure. The valve is attached by a rod to a short cylinder, the lower part of which is open, and dips into a channel or groove containing mercury. The cylinder covers and surrounds the inlet passage: thus, as the gas flows from the main through the inlet of the regulator, it exerts an upward pressure on the cylinder, which is adjusted by means hereinafter described, to admit the requisite quantity of gas for the supply of the burners. If the pressure of gas issuing from the main be increased, it lifts the cylinder which closes the valve; but the consumption by the burners quickly reduces the pressure within the regulator: this causes the cylinder to fall and open the inlet passage.

Fig. 1.

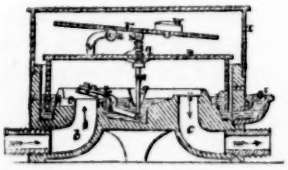


Fig. 1, is a vertical section of the regulator arranged for use. *a*, is a cast iron cylindrical vessel or box; *b*, is the inlet; and *c*, the outlet passage. The passage *b*, is closed by a valve. *d*, is a recess cast in the lower part of the box *a*, and forming a small cistern or reservoir to receive mercury when the regulator is adjusted for use. *f*, is a channel or groove for containing mercury; this communicates with the channel *g*, which conveys the mercury into the cistern or recess *d*.

The mercury or other suitable fluid is poured into the regulator through the tube g^1, by which it is conveyed to the recess *d*, and channels *f*, *g*. *h*, is the valve-seat, which is secured by screws to the box *a*. *i*, is the valve, the rod *k* of which is jointed at *l*, to the seat *h*. To the outer end of the rod *k*, is jointed a small rod or spindle, which supports the cylinder. A groove or channel *n*, is formed in the valve-seat *h*, which surrounds the valve: when this is filled with mercury or other suitable fluid, the valve dips into it, and forms a gas-tight joint. When the valve is secured to the box *a*, the joint of the valve-rod is within the recess *d*, and below the surface of the mercury, as also is the joint of the rod *m*. This arrangement prevents the clogging of the joints, arising from the deposit of oily and bituminous matters. *m*, is the rod or spindle secured at one end to the valve-rod *k*: at the upper part is a nut *o*, upon which the cylinder *p*, rests. The cylinder is made of iron, or other suitable material, and open at the bottom. It is secured to the rod *m*, by a nut, which is screwed down upon the cylinder; and disks or washers of leather are placed between the nuts to render the joint gas-tight.

At the top of the rod *m*, is an eye, to which is fastened a metal bar *r*, by a pin passing through the lugs *s*. The bar *r*, is supported by a rod *t*, which passes through the lug *u*; and the ends of the rod *t*, are supported by the pins or brackets *v*, screwed in the edges of the box *a*. This bar *r*, is perforated, to receive a small weight *w*, by which the pressure of the bar *r*, on the cylinder *p*, is regulated. If it be placed at the back of the fulcrum *u*, or to the left-hand side, as shown, the pressure may be wholly taken off the cylinder *p*; and it will be gradually increased as the weight is moved along the bar. When the regulator is to be adjusted for use, after attaching it to the inlet and outlet pipes, the channel *p*, the recess *d*, and the grooves *f*, *g*, are to be filled with mercury, by pouring it into the pipe or tube g^1, until the metal is nearly evel with the top: a nut is then screwed in the pipe g^1, the gas turned

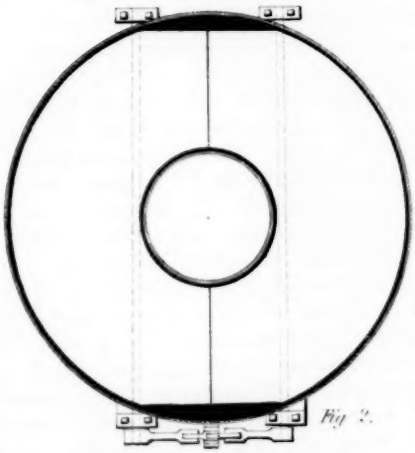


Fig 2.

Fig 3.

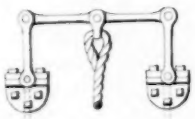


Fig 4.

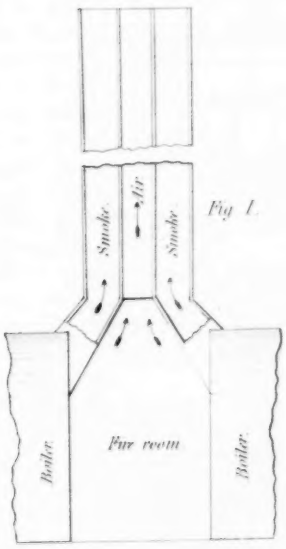


Fig 1.

on, and the weight *w*, put in a position so as nearly to balance the cylinder *p*, when the gas is pressing it upward. Any increase of pressure from the main will lift the cylinder *p*, which causes the valve *i*, to descend, and shut or partially close the inlet until the pressure becomes uniform. On the contrary,—should the pressure from the main decrease, the cylinder will descend and open the inlet passage to a greater extent. The regulator being properly adjusted as before described, the cover *x*, is put on to secure the internal parts from injury: the apparatus will then require no further attention.

A modification of the foregoing is represented in vertical section at fig. 2. It consists of a cylindrical box *a*, *a*; of which *b*, is the inlet, and *c*, the outlet passage. Into the bottom of the vessel is screwed the piece of brass *d*, or other metal, the inside of which is grooved out, as shown at d^1. The valve *e*, is hollow, and slides over the piece of metal *d*; and three or four steadying pins project from the inside of the valve to keep it equidistant from the metal *d*. The valve is attached to a rod *f*, to which the cylinder *g*, is secured, as in the arrangement before described. The lever *h*, and other working parts, being above the cylinder, are not within the influence of the gas. The pressure of the lever on the cylinder is adjusted in the same manner as before described. When the cylinder is lifted, the valve is drawn upward, and the angular edge of the aperture i^1, in the partition *i*, dips into the groove formed round the top of the valve, by the edge e^1, rising a short distance above the curved top. The groove is filled with mercury, to make a gas-tight joint when the edge of the partition *i*, dips into it. One or more apertures are made in the upper part of the valve to maintain an equality of pressure on poth sides of the valve. The direction of the gas as it passes through the regulator is indicated by arrows.

Fig. 2.

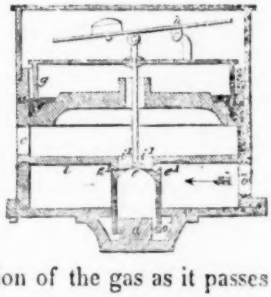
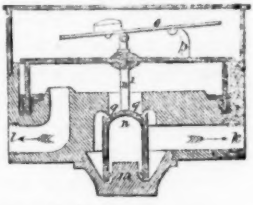


Fig. 3, is a vertical section of another arrangement of regulator: *k*, is the inlet, and *l*, the outlet passage; *m*, is a grooved piece of metal containing mercury; *n*, the valve connected to the rod n^1; *o*, the lever; and *p*, the lever-supports. When the valve is lifted by a variation of the pressure, the curved edge of the metal *q*, dips into the mercury; thus stopping the passage of the gas. The action of the other parts of the apparatus is similar to the foregoing. In all cases the regulators are to be provided with covers, as shown in the figures. The material preferred for the manufacture of the valves is malleable iron coated with tin, in order that the mercury surrounding the valve may adhere to it when it descends, and make the joint gas-tight.

Fig. 3.



The patentee claims the construction of the apparatus for regulating the flow of gas, substantially as herein described and shown.

For the Journal of the Franklin Institute.

Particulars of the Steamer Joseph Whitney.

Hull built by John Englis, New York; Machinery by Neptune Iron Works, New York; Intended service, Baltimore to Boston.

HULL.—

Length on deck, from fore part of stem to after part of stern post, above the spar deck,	200 feet.
Breadth of beam at midship section,	33 "
Depth of hold,	9 "
" " to spar deck,	16 " 6 inches.
Length of engine and boiler space,	68 "
Draft of water at load line,	11 "
" " below pressure and revolutions.	11 "
Tonnage, custom-house, 1000.	
Area of immersed midship section at this draft,	308 sq. feet.
Masts and rig, foretopsail schooner.	

ENGINE—Vertical beam.

Diameter of cylinder,	52 inches.
Length of stroke,	11 feet.
Maximum pressure of steam in pounds, 25.	
Cut off, $\frac{1}{2}$.	
Maximum revolutions per minute, 18.	

BOILER—One—Rising flue.—

Length of boiler,	28 feet.
Breadth "	14 " 9 inches.
Height " exclusive of steam chimney,	10 " 2 "
Number of furnaces, 4.	
Breadth of "	3 " 4 "
Length of grate bars,	7 " 3 "
Number of flues, (upper return,) 8.	
Internal diameter of flues,	16¼ "
Heating surface, (fire and flues,) 2303 sq. feet.	
Diameter of smoke pipes,	55 "
Height, "	35 feet.
Description of coal, Bituminous.	
Draft, Natural.	

PADDLE WHEELS.—

Diameter,	29 feet.
Length of blades,	7 " 6 inches.
Depth "	18 "
Number " 26.	

Remarks.—Floor timbers at throats, *molded*, 14 inches;—*sided*, 14 inches;—distance of frames *apart at centres*, 24 inches. Frame strapped with diagonal and double laid iron straps 4 by $\frac{5}{8}$-inch. C. H. H.

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*On Hutchison's Process for Indurating and rendering impervious to moisture Sandstone and other Porous Stones, Plaster of Paris, &c.**

Some time ago, when a French inventor, M. Rochas, was seeking to introduce his process for silicatising soft stone, and even for staying the progress of decay in stone buildings already erected, we spoke of Mr. William Hutchison's patent for indurating and rendering impervious to

* From the London Builder, No. 613.

moisture soft sandstone and other porous stones, plaster of paris, and various absorbent materials. Since that time a company has been formed to carry out the patent, and we have taken an opportunity which was offered us to inspect the works, and to examine some of the examples of the indurated stone which have been longest exposed to wear and the weather. The works at present in operation are at King's Quarry, close to Tunbridge Wells, which is held under a lease from the Earl of Abergavenny, and furnishes a stone so soft and friable that it may be reduced to powder with very little difficulty. The sandstone, grits, &c., are affected by the weather, either by the mechanical effects of moisture admitted into the interstices, or through the decomposition of the matter cementing the particles together; and Mr. Hutchison's patent, it will be seen, fights against both these operations. The process is extremely simple; perhaps we ought to say the processes; at all events, two modes are employed, the one changing but slightly the color of the stone, the other rendering it much darker, in fact, nearly black. The latter is much the cheaper process, and is performed with ordinary gas tar, purified, and to some extent changed by successive boilings. In a large tank of this, over a furnace, the pieces of stone are placed, and remain on an average about six hours. In some pieces that we broke, the tar had penetrated three or four inches on all sides, and in others had permeated the whole mass. After the stone has been taken out of the tank and cooled, the surface is cleaned off. To preserve a light color the stone is dipped into boiling resin instead of tar.

By the process the stone is made very hard, its specific gravity is considerably increased, and it is rendered non-absorbent. A three-inch cube of stone prepared by the first described mode, after being steeped in water for twelve hours, had gained no appreciable increase of weight; while a similar cube of the stone, in its natural state, absorbed two ounces and a half of water. The stone of which we are speaking, is altogether useless in its natural state. Searching for specimens of the prepared material which had been exposed for some time, we found a tomb-stone that had been out for three years, whereof the arrises were perfectly sharp and untouched; a *grindstone* which had been in use four years, and some pavement lozenges of the black and white alternately, that had been laid the same number of years, and were very sound. Being impervious, it serves to keep down the damp. Copings, sinks, and horse-troughs, appeared to have stood well. For use in hydraulic works, sea walls, dock-basins, tanks, &c., it would appear to have strong claims. We should add that the invention is not confined to stone in a solid state; pounded sandstone or other material may be mixed with loam and rendered hard and impervious by introduction to the tank. We found the workmen, in this way, manufacturing stable-pitching, out of material otherwise useless.

The *Sussex Advertiser* looks to the invention hopefully, as promising great results as regards the district, which has at present, "so to speak, no special manufacture, no distinctive 'staple' of industrial trade." "The important merit," says the writer, "in Mr. Hutchison's invention is the striking fact, that out of two materials—each comparatively valueless in

itself, viz: sandstone and gas tar—he produces by direct amalgamation, under certain processes, a most valuable and highly useful commodity. It has been held that that man is a benefactor to his country who can make two blades of grass grow where only one grew before; Mr. Hutchison has done more; he has taught us to convert two bodies, nearly useless in themselves, into a material whose uses can scarcely be circumscribed; while, be it added, this material can be furnished at a rate little beyond, we believe, half the usual cost of ordinary stone."

Sir Roderick Murchison, the well-known eminent geologist, has expressed an unqualified opinion in favor of the process. In a letter to the patentee, Sir Roderick says: "Believing that your method of indurating the soft sandstone of this neighborhood, and of rendering a material which is so easily worked as *durable as the hardest rock*, and quite impenetrable to moisture, I sincerely wish you may have that success to which you are justly entitled. It is manifest that, in a climate like this, a cheap building stone, which *throws off wet and never can absorb it*, must be highly valuable, not only in the construction of houses, but in all hydraulic, paving, and monumental work." He goes on further to say: "When I further know that every sort of decoration can be chiseled out at the very slightest expense, and with great rapidity, and that in a few hours the material can be rendered *an indestructible rock, with edges that can only be destroyed by violence, and never can be affected by weather*, I conceive that your patent only requires to be known in order to be generally appreciated." We do not go as far as this: we may not pretend to say that the stone as thus prepared "*never can* be affected by weather." Time must settle that question. But it certainly does seem clear to us that in many localities, and for many purposes, the process we have been describing may be employed with very great advantage to the public, and much profit to the owners of the patent.

There are two architects, we observe, connected with the company, namely, Mr. N. E. Stevens, of Tunbridge Wells, (who, by the way, has built some picturesque houses there and in the neighborhood,) and Mr. Edward Roberts, of London. We sincerely hope the undertaking may prove successful.

For the Journal of the Franklin Institute.

Holstrom's Improved Air Lock for the Sinking of Hollow Iron Piles, Coffer Dams, &c.

Many of the readers of the *Journal*, have no doubt heard of the process of Dr. Potts, in England, for sinking hollow iron piles, which process consisted in simply closing the upper end of the pile air-tight, the lower end being left open, and having a thin edge for the more readily cutting its way. The pile having been set in a vertical position, a pipe is attached to the top bonnet, and a communication opened between the interior of the pile and a large exhausted receiver, the pile, as it were, receives a blow from the atmosphere, caused by the partial vacuum which is instantly formed within it; the pumps which formed the vacuum in the receiver are kept constantly at work, and bring up from the

inside, water, sand, gravel, &c., or whatever may be the formation in which the pile is being sunk; if, however, any opposing obstacle is encountered through which the atmospheric pressure on the top and hydrostatic pressure at the sides cannot force, it becomes necessary to resort to other means, and it is at this stage of the operation that Holstrom's improvement becomes essential to a successful prosecution of the work.

The Wilmington and Manchester Railroad Company, in crossing the Great Pee Dee River, in South Carolina, have put down a bridge composed of these piles; whole length of bridge, 335 feet; width, 18 feet 6 inches; there are two spans of 130 and 135 feet, and one of 70 feet, which is used as a draw for steamboats. In this bridge there were used seven hollow cast iron piles, 6 feet diameter, 2 inches thick, and 53 feet long, weighing about 25 tons each. In sinking the first pile, when it had gone down 7 feet 10 inches, it was found to have met with an obstruction which prevented further progress. On examination, the obstruction was found to be a large cypress tree, covering one-half the bottom area of the cylinder; its removal became a matter of necessity. By the use of Mr. Holstrom's improved air lock, patented January 2d, 1855, further operations may be immediately carried on. The air lock is a chamber bolted to the top of the pile, and having suitable openings at the top communicating with the atmosphere, and at the bottom communicating with the inside of the pile. As soon as the pile is obstructed, the doors in the air lock are opened, and the workmen enter the pile. The pumps, which had previously exhausted the air, are now reversed and air forced in until all the water inside the pile is expelled, when the men work at and remove the obstacle that opposes the pile. As fast as it is removed from below, it is placed in the air lock, the inner doors of which are open, and the outer ones closed. When the lock is filled, the inside doors are closed, and the outer doors are opened when the lock is emptied; by this means a constant pressure is kept within the pile, and men and material can be passed in or out at pleasure, without interfering with the operation. N.

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*The Mints of France.**

France possesses seven mints; before 1814 there were as many as eighteen, but at that period eleven were suppressed, including the following among others,—Bayonne, La Rochelle, Limoges, Nantes, Perpignan, and Toulouse. Each of the existing establishments make use of a peculiar mark on its coinage to designate the mint in which it is struck. Thus the coins of the Paris mint bear the letter A; Rouen, B; Lyons, D; Bordeaux, K; Strasbourg, BB; Marseilles, MM; Lille, W. But of these seven, Paris is the only mint that has kept up an uninterrupted coinage of gold and silver money; and it is only since the copper coinage was re-melted that the provincial mints have evinced any activity.

It is a known fact, that the coinage in France is not undertaken by the State, but by contractors, who are styled Directors of the Manufacture, and who are subjected to a system of superintendence and registration.

* From the London Mechanics' Magazine, October, 1854.

The State allows them for cost of coinage at the rate of a franc and a half per kilog of silver (about 2 lbs.,) and six francs for the same weight of gold. The directors of the mint are required to supply one-fortieth of the silver coinage in fractional parts of the five-franc piece; that is to say, 25,000 francs worth out of every million of francs. It is thus distributed, —5250 francs worth (or about 210*l.*) of 2 franc pieces; 12,250 francs worth (or 490*l.*) of franc pieces; 6250 francs worth (or 250*l.*) of pieces of 50 centimes; and 1280 francs worth (or 50*l.*) of pieces of 20 centimes. The tenth part of the gold coinage is to be in ten franc pieces. The cost of the copper coinage is a franc and a half (about 1*s.* 3*d.*) per 10,000 francs worth (or 400*l.*) It is difficult to form an idea of the magnitude of the arrangements of the Paris mint. The results already attained are astonishing; nor less so are those within the reach of its machinery, such as the furnaces, crucibles, rolling mills, presses, milling and cutting apparatus, &c., which are contained in a comparatively small compass. Two steam-engines of 30 horses power work the various apparatuses which prepare the strips for feeding the coining presses. Each press, attended by a single workman, strikes off 50 coins per minute, and might be made to work off 60 by slightly increasing the speed. It is calculated that if each press were to strike off 50 coins per minute during 12 hours per day for 300 days in the year, the 16 presses would produce nearly 3,500,000,000 francs (or 140,000,000*l.*) worth of 20 franc pieces; 1,700,000,000 francs (or 68,000,000*l.*) worth of 10 franc pieces; 864,000,000 francs (or 34,560,000*l.*) worth of 5 franc pieces; 639,360,000 francs (or 25,574,400*l.*) worth of pieces of 2 francs, 1 franc, 50 and 20 centimes; and above 31,000,000 (or 1,240,000*l.*) worth of pieces of 5, 2, and 1 centimes.—*Translated from Moniteur Industriel.*

To the Editor of the Franklin Institute Journal:

In page 90, August number of the *Practical Mechanics' Journal*, is a notice of a method of securing a piston upon its rod, which we think is original with our Lewis Taws, and was first used at our establishment. The drawing from which the cut was taken, was furnished by us.

We have for several years secured all our large pistons in this manner, and are satisfied that it is an improvement.

Other engineers have understood its value, and are using it. As there is no patent claim for the arrangement, it seems proper, that any credit which may attach to it, should accrue to its originator.

We shall be gratified, if you will copy the article referred to, for the *Journal of the Institute.*

We are very truly,

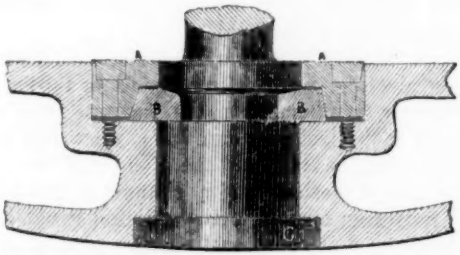
I. P. Morris & Co.,
Port Richmond Iron Works.

Philadelphia, January 23, 1855.

Method of securing a Piston upon a Rod.

The firm of I. P. Morris & Co., of Philadelphia, about the year 1850, originated a mode of securing a piston upon its rod, which has since been adopted in all engines constructed by them, and is now beginning to attract some attention in other quarters. The rod is forged considerably larger than usual at the end, and is held so that the impulse of the piston

in either direction is received fair upon a collar, instead of, as usual, bearing a wedge-wise one way, and on the narrow base of a cutter the other way. The annexed figure is a vertical section through the central portion of a piston, exposing the piston-rod in position, with the loose ring, A, held down by a few light bolts. This ring is formed with an inner conical surface, embracing two half rings, B, which enter a groove in the piston-rod. The downward pressure of the ring, A, tightens the pieces, B, upon the rod.



These wedge-pieces, B, correspond to the key of the ordinary fastening, and bear the whole force of the piston while on the upward stroke, the downward strain being borne by the still larger collar, C, on the end of the piston-rod. The pieces, B, are so formed, that, when fairly in place, they make a nearly continuous ring around the piston-rod. Being set up twice, once when cold, and again when heated, a strong, fair, and perfectly rigid joining is secured for these important parts, which are subjected to no trifling amount of strain. The steamer *Mississippi*, running on Lake Erie, the first large boat in which this device was ventured on, has a cylinder 81 inches in diameter, and employs a plus pressure during a portion of the stroke, of as much as 30 lbs. per square inch. Add to this, 10 lbs. for vacuum, subtract 1 lb. for friction, and a very simple calculation shows the alternate thrust and pull on the piston-rod to be something more than 200,000 lbs. There is no patent for this fastening, which has so far proved in every case perfectly successful.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, January 18, 1855.

Samuel V. Merrick, President, in the chair.

John F. Frazer, Treasurer.

John P. Parke, Recording Secretary, pro tem.

The minutes of the last meeting were read and approved.

A letter was read from the Metropolitan Mechanics' Institute, of Washington City, D. C., and referred to the Committee on Instruction.

Donations to the Library were received from the Royal Astronomical Society, and the Statistical Society, of London; the National Observatory, Washington City, D. C.; the Maryland Institute, Baltimore, Md.;

Charles B. Norton, Esq., City of New York, and Messrs. J. K. Lippincott and George M. Conarroe, of Philadelphia.

The periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and expenditures for December; also, his annual statement for 1854.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Publications submitted their Annual Statement of the financial operations of the Journal.

At the request of the Committee on Minerals, &c., the regulations submitted at a former meeting, were referred back for further consideration.

New Candidates for membership in the Institute (10) were proposed, and those proposed at the last meeting (157), were duly elected.

Mr. Merrick said that, having held the office of President for the past thirteen years, he had requested that a change should be made at this election in the presiding officers, believing that it would be to the advantage of the Institute that occasional changes should be made in those offices.

A letter was read from Thomas Fletcher, Esq., approving of the proposition to make a change in the presiding officers.

The Tellers of the Annual Election for Officers, Managers, and Auditors, for the ensuing year, reported the result, when the President declared the following gentlemen as duly elected:—

John C. Cresson, President.

John Agnew, Matthias W. Baldwin, } Vice Presidents.

Isaac B. Garrigues, Recording Secretary.

Frederick Fraley, Corresponding Secretary.

John F. Frazer, Treasurer.

MANAGERS.

Samuel V. Merrick,	Owen Evans,	Charles E. Smith,
Thomas Fletcher,	Alan Wood,	John McClure,
Abraham Miller,	John E. Addicks,	George Erety,
John C. Trautwine,	Isaac S. Williams,	Evans Rogers,
John H. Towne,	Henry P. M. Birkinbine,	Robert Cornelius,
Edwin Greble,	George W. Conarroe,	Lawrence Johnson,
David S. Brown,	Thomas J. Weygandt,	George C. Howard,
Thomas S. Stewart,	Joseph J. Barras,	Harman Baugh.

AUDITORS.

Samuel Mason, Algernon S. Roberts, James H. Cresson.

At a meeting of the Board of Managers, held January 24th, 1855, the following officers were elected for the ensuing year.

Isaac S. Williams, Chairman.

Thomas J. Weygandt, Owen Evans, } Curators.

Washington Jones presented to the notice of the meeting, some specimens of Japanese arts and manufactures, brought by an officer attached to the Japan Expedition. Among them was an umbrella, or rather a sun-shade, made in an exceedingly neat manner; the material being nearly all of bamboo, or a similar wood; the covering of oiled paper pasted to the stretchers. No metal, except a piece of iron wire to make a catch, to keep the slide in its position when the article is opened.

Some sheets of the paper used by them to write upon, having a resemblance to tissue paper, soft, and with little or no sizing; yet it is said that with a suitable pen, and the ink (resembling that of the Chinese, and probably identical with it in its manufacture,) used by them, it can be written upon with ease and rapidity.

Also, a stuff, seemingly made of the waste silk rejected as unfit for weaving, which appears to have been manufactured by spreading the material into a very thin flake, saturating it with a gummy substance, then drying it, and finally stamping it upon one side with figures of various designs. This is applied to the purposes of a pocket-handkerchief, the only difference in the application being this; the Japanese article performs its office but once. A number of pieces, each of a sufficient size to accomplish its purpose, are carried about the person; when necessity requires, a piece is used, and then thrown away as unfit to be returned to the pocket. A trial proves the stuff to be unable to withstand washing, the water dissolving the substance that binds the fibres together, and reducing them to a mass.

There were also some beautiful specimens of domestic utensils made of wood, bowl-shaped, provided with covers of the same material, and coated with red and black lacker, highly polished, and ornamented with figures of animals, scenery, &c., laid on with white and yellow metal. These vessels are used to contain warm food, and are cleansed with hot water without sustaining injury.

The specimens of porcelain cups shown, were very fine, transparent, and entirely free from blemish. When held between the light and the eye, there may be seen portions that transmit the rays more readily, and which are so disposed as to make continuous lines that form figures of a regular design.

The interior surface of the cups are ornamented with views of Japanese scenery, alphabetical characters, and foliage, laid on with white metal, like that on the wooden vessels, and similar in design to those of the Chinese, but much more artistically executed. All the articles shown, compared very favorably, in point of finish and display of taste, with those of a like kind made in China.

Mr. J. F. Mascher exhibited a stereoscopic locket, of his invention. It is so arranged that the two pictures, with the appropriate lenses, are contained in a medallion of ordinary size. The pictures are covered by plano-convex lenses, instead of flat glass, by which improvement the ordinary secondary reflexion is avoided. The lenses for viewing the portrait are double convex, of two inches focus; these may be combined when desired for viewing ordinary objects.